First Five-Year Review Report
For
Rocky Flats Environmental Technology Site
Golden, Colorado

July 2002

Prepared by:
U.S. Department of Energy
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Approved by: **Date:**

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ACRONYMS

ALF	Action Levels and Standards Framework for Surface Water, Groundwater, and Soils
Am	Americium
APCD	Air Pollution Control Division
ARAR	Applicable or Relevant and Appropriate Requirement
ATSDR	Agency for Toxic Substance and Disease Registry
CAD/ROD	Corrective Action Decision/Record of Decision
CDH	Colorado Department of Health
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHWA	Colorado Hazardous Waste Act
CMS/FS	Corrective Measure Study/Feasibility Study
COC	contaminant of concern
CRA	Comprehensive Risk Assessment
D&D	Decontamination & Decommissioning
DOE	U.S. Department of Energy
dpm	disintegrations per minute
EPA	Environmental Protection Agency
FWPCA	Federal Water Pollution Control Act
FY	Fiscal Year
GAC	Granular Activated Carbon
HDPE	High Density Polyethylene
HHRA	Human Health Risk Assessment
HRR	Historic Release Report
IAG	Interagency Agreement
IDM	Investigative Derived Material
IGD	Implementation Guidance Document
IHSS	Individual Hazardous Substance Site
IM/IRA	Interim Measure/Interim Remedial Action
IMP	Integrated Monitoring Plan
ITS	Interceptor Trench System
K-H	Kaiser-Hill Company, L.L.C.
LARSD	Laboratory and Radiation Services Division
LDR	Land Disposal Restriction
LHSU	lower hydrostratigraphic unit
MEI	maximum exposed individual
mg/l	milligrams per liter
MLLW	Mixed Low Level Waste
nCi/g	nanocurie per gram
NFA/NFRA	No Further Action/No Further Remedial Action
NPL	National Priority List
O&M	operation and maintenance

OPWL	Original Process Waste Lines
OU	Operable Unit
PAM	Proposed Action Memorandum
PCB	polychlorinated biphenyl
PCE	tetrachloroethane
pCi/g	picocuries per gram
pCi/l	picocuries per liter
POC	point of compliance
POE	point of evaluation
ppm	parts per million
PPRG	Programmatic Preliminary Remediation Goal
Pu	plutonium
RCRA	Resource Conservation and Recovery Act
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RFI/RI	RCRA Facility Investigation/Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RSAL	Radionuclide Soil Action Level
SEP	Solar Evaporation Ponds
Site	Rocky Flats Environmental Technology Site
SPP	Solar Pond Plume
STP	Sewage Treatment Plant
TCA	1,1,1 Trichloroethane
TCE	Trichloroethane
U	uranium
µg/100CM^2	micrograms per 100 square centimeter
µg/l	micrograms per liter
UHSU	upper hydrostratigraphic unit
UST	underground storage tank
VOC	volatile organic compound

Executive Summary

In October 2001, The Department of Energy's (DOE) Rocky Flats Field Office initiated the first Five-Year Review as required by the Comprehensive Environmental Response Compensation and Liability Act (CERCLA). A final Corrective Action Decision/Record of Decision (CAD/ROD) has not yet been completed for the entire site. However, a CAD/ROD has been completed for Operable Unit 1 (OU 1), 881 Hillside and for OU 3, Offsite Areas, and several accelerated actions have been completed. Consequently, the scope of this first site-wide Five-Year Review included a review of the CAD/RODs for OU 1 and OU 3 and the accelerated actions completed as of September 30, 2001. Accelerated actions analyzed in this five-year review included: Trench T-1, Trench T-2 (Ryan's Pit), Trenches T-3 and T-4, the Mound Site, the East Trenches Reactive Barrier, the Mound Plume Reactive Barrier, the Solar Pond Plume Reactive Barrier, Solar Ponds Sludge Removal Action, OU 7 Seep, and the Underground Storage Tank accelerated action. The trigger for this five-year review was the signing of the CAD/ROD for OU 3 in May 1997.

The assessment of this first five-year review concluded that ongoing custody and control of the Site by DOE, monitoring programs, and restriction of public access serve to adequately control risks posed by contamination at RFETS at this time. In addition, DOE has every intent to close the Site in a manner that is protective of human health and the environment. The final site-wide remedy will be developed as part of the Remedial Investigation/Feasibility Study process resulting in a final CAD/ROD that will be protective when implemented.

For OU 1 and OU 3, the remedy as discussed in this report is protective. The accelerated actions analyzed during this Five-Year Review have addressed the immediate hazards. Further, for the most part, the accelerated actions are functioning as intended. Deficiencies are noted in section 9.0, Issues, and are addressed in section 10.0, Recommendations.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name: Rocky Flats Environmental Technology Site		
EPA ID: C57890010526		
Region: 8	**State:** CO	**City/County:** Golden/Jefferson
SITE STAUTUS		
NPL STATUS: ☒ Final ☐ Deleted ☐ Other (specify)		
Remediation Status (choose all that apply): ☒ Under Construction ☐ Operating ☐ Complete		
Multiple OUs? ☒ YES ☐ NO		**Construction Completed Date?** N/A
Has site been put into reuse? ☐ YES ☒ NO		
REVIEW STATUS		
Lead Agency: ☐ EPA ☐ State ☐ Tribe ☒ Other Federal Agency Dept of Energy		
Author name: Reginald W. Tyler		
Author title: ER Team Lead		**Author affiliation:** U.S. Dept. of Energy, RFFO
Review Period: 10/1/2001 to 4/31/02		
Date(s) of site inspection: 2/13/2002 and 3/5/2002		
Type of review: ☒ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only ☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead ☐ Regional Discretion		
Review number: ☒ 1 (first) ☐ 2 (second) ☐ 3 (third) ☐ Other (specify)		
Triggering action: ☐ Actual RA On-site Construction at OU #_____ ☒ Actual RA Start at OU # 3 ☐ Construction Complete ☐ Previous Five-Year Review Report ☐ Other (specify)		
Triggering action date - May 1997 – OU 3 CAD/ROD		
Due date *(five years after triggering action date):* May 2002		

[*OU refers to operable unit.]

Five-Year Review Summary Form, Continued

Issues:

The effectiveness of the Solar Pond Plume Reactive Barrier is questioned due to the potential to by pass the treatment cell.

Containerized waste from Trench 1 containing depleted uranium (DU) contaminated with PCBs does not have an identified treatment or disposal option.

Recommendation and Follow-up Actions:

Evaluate and implement corrective actions for the Solar Pond Plume Reactive Barrier to address the potential to by pass the treatment cell. Continue to monitor effluent water quality to ensure surface water standards are met.

Continue to store PCB contaminated DU in compliant storage until treatment/disposal options are identified and implemented.

Protectiveness Statements:

The remedy for OU 1, 881 Hillside, is protective.

The remedy of no action for OU 3, Off-site Areas, is protective.

Accelerated actions reviewed in this report have address immediate threats. Accelerated actions are functioning as intended with the exception of the Solar Pond Plume Reactive Barrier system. Options to address deficiencies of this system are being evaluated and should be implemented within the next eighteen months.

Long-term Protectiveness:

Long-term site-wide protectiveness will be verified once the site-wide Corrective Action Decision/Record of Decision (CAD/ROD) is selected and implemented. It is estimated that the site-wide remedy will be in place by December 2006. Long-term monitoring and institutional controls will continue well beyond December 2006 to ensure continued protectiveness of the remedy.

Other Comments:

None.

1.0 INTRODUCTION

The United States Government, through the U.S. Atomic Energy Commission, acquired land and established the Rocky Flats Plant in 1951. Rocky Flats Plant was renamed the Rocky Flats Environmental Technology Site (RFETS or Site) in 1995. The RFETS is currently under the control and jurisdiction of the U. S. Department of Energy (DOE). The RFETS consists of approximately 6,265 acres of federally owned land. Major structures at the Site are located within an area of 384 acres known as the Industrial Area. The RFETS is located approximately 16 miles northwest of downtown Denver and about ten miles from the cities of Boulder, Golden, Westminster, and Arvada.

The Rocky Flats Plant began operation in 1952. The Plant's primary mission was the production of component parts for nuclear weapons. During the course of operations, industrial accidents and waste disposal practices caused releases of hazardous substances, including radioactive materials, to the environment. The Plant was placed on the National Priorities List (NPL) in 1989 and is being cleaned up under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) as a Superfund site.

Section 121 (c) of CERCLA as amended by the Superfund Amendments and Reauthorization Act of 1986, and EPA Comprehensive Five-Year Review Guidance dated June 2001 (EPA 2001), require that remedial actions resulting in any hazardous substances, pollutants, or contaminants remaining above levels that allow for unlimited use and unrestricted exposure be reviewed not less than every five years to assure protection of human health and the environment. This requirement applies to the RFETS, and this is the first site-wide Five-Year Review of the CERCLA remedies and accelerated actions that have been implemented at the RFETS.

The site-wide Five-Year Review was conducted from October 2001 through May 2002, and this report documents the results of the review. The purpose of the Five-Year Review is to determine whether the implementation of a remedy at a site is protective of human health and the environment and that it will remain protective when it is complete. For elements of the remedy that are under construction, or are yet to begin, the purpose of the review is to confirm that the accelerated actions that have been have implemented have addressed the immediate threats to the environment.

EPA guidance (EPA 2001) suggests the Five-Year Reviews to be conducted on a site-wide basis. The RFETS has not yet completed a final Corrective Action Decision/Record of Decision (CAD/ROD) for the entire site. However, a CAD/ROD has been completed for Operable Unit 1 (OU 1), 881 Hillside and for OU 3, Offsite Areas, and several accelerated actions have been completed. Consequently, the scope of this first site-wide Five-Year Review will include a review of the CAD/RODs for OU 1 and OU 3 and the accelerated actions completed as of September 30, 2001. Although the remedy for OU 3 did not leave contaminants above levels that allowed for unlimited use and unrestricted exposure, due to substantial public interest in OU 3, DOE committed to conducting a limited review. The schedule for conducting this Five-Year Review is based on the May 1997 date of the final OU 3 CAD/ROD and in accordance with the letter from EPA dated March 6, 2000 (EPA 2000).

CAD/RODs have also been completed for OU 11, West Spray Field, OU 15, Inside Building Closures, and OU 16, Low Priority Sites. For these three Operable Units the CAD/ROD indicates a five-year review is not required. This is because hazardous substances, pollutants, or contaminants do not remain above levels that allow for unlimited use and unrestricted exposure.

The RFETS is currently developing and/or implementing Rocky Flats Cleanup Agreement (RFCA) accelerated actions to decommission, decontaminate, and demolish the production buildings and associated support structures and utilities, and to clean up discharges of hazardous substances to the soils and groundwater at the Site. The accelerated actions will be factored into the final action for the RFETS, as developed and evaluated in the Remedial Investigation/Feasibility Study (RI/FS) and documented in the Site CAD/ROD.

2.0 Rocky Flats Environmental Technology Site Remediation Chronology

Date	Event
April, 1952	Operations began at Rocky Flats on production of a plutonium component for use in atomic weapons.
September 11, 1957	A fire in building 771 caused extensive contamination to the building and release of some plutonium to the environment.
1967	Large-scale leaking of waste oil drums being stored on the 903 Pad occurred contaminating the soils with plutonium, machining lubricants, and chlorinated solvents.
May 11, 1969	A plutonium glovebox fire that started in building 776 spread to several hundred connected gloveboxes in building 776 and building 777. The fire resulted in extensive restoration property loss.
1968 - 1970	From 1968 through 1970 some of the radiologically-contaminated material was removed from the 903 Pad and Lip area, some of the surrounding Lip Area was regraded, and much of the area was covered by an imported base coarse material. Contaminated soil became wind-borne and settled near the lip area. An asphalt cap was placed over the most contaminated area resulting in the 903 Pad.
September, 1973	A tritium release was discovered in a water sample taken from Woman Creek by the Colorado Department of Health (CDH). An EPA report indicated that 50-100 curies of tritium reached Great Western Reservoir
September 24, 1984	A cleanup effort began on a quarter-mile strip of dirt on the 903 Lip Area.
June 6, 1989	Some 80 agents of the Federal Bureau of Investigation and EPA arrived at the plant to carry out a search warrant filed in the U.S. District Court of Colorado. The warrant authorized the agents to search for evidence of alleged criminal violations of the Resource Conservation and Recovery Act and the Federal Water Pollution Control Act.
September 21, 1989	Rocky Flats was added to the National Priorities List (NPL) of highly polluted sites destined for cleanup. This required DOE to enter into an interagency agreement with EPA for the regulation of site investigations and cleanup.
January 10, 1990	Groundbreaking occurred for construction of a system to remove chemical contaminants from groundwater at OU 1- 881 Hillside area, a high priority cleanup site at the plant. The action followed EPA and CDH approval of an Interim Measures/Interim Remedial Action Plan for the OU.
January 22, 1991	The Interagency Agreement (IAG) between DOE, CDH and EPA was signed. The agreement outlined multi-year schedules for environmental restoration studies and remediation. The IAG grouped the Individual Hazardous Substance Sites (IHSSs) into 16 larger operable units (OUs).
February 7, 1991	A subcontract was awarded to begin preparation for removal of up to 750,000 gallons of sludge from the solar evaporation ponds. The ponds were being emptied as part of an agreement with the CDH and EPA to accelerate the cleanup of OU 4, which includes the five Solar Ponds. The sludge would be mixed with cement to form pondcrete.
October 3, 1994	Final confirmation sampling was completed after removal of six hot spots from the 881 Hillside. This remedial action laid the groundwork for the

Date	Event
	planning and approval process for prioritizing and conducting future accelerated cleanup actions for IHSSs.
November 1994	OU 16 (Low Priority Sites) became the first OU to be officially closed out under the IAG as a No Action CAD/ROD. OU 16 consisted of five individual hazardous substance sites.
January 15, 1995	The last of the five Solar Evaporation Ponds that make up OU 4 was emptied, when sludge removal was completed pursuant to an IAG milestone.
August 31, 1995	Accelerated cleanup of Ryan's Pit, a former chemical waste dump, began. An estimated 3,000 gallons of chemical wastes had been dumped in Ryan's Pit when it was used as a disposal site from 1966 to 1970. Excavation was completed in September.
October 23, 1995	Records of Decision were signed concluding that no cleanup action was necessary for OU 11 (West Spray Field) and OU 15 (Inside Building Closures).
February 21, 1996	A new leachate treatment system located at the east face of the OU 7 (Present Landfill) became operational. The project was initiated in 1994 as a result of the Pondwater Interim Measure/Interim Response Action (IM/IRA).
June 4, 1996	A major accelerated cleanup project began involving the excavation of Trenches 3 and 4, two of the top 10 priority hazardous substances sites at Rocky Flats. The trenches had been used primarily for the disposal of radioactively contaminated sanitary sewage sludge.
July 19, 1996	The RFCA was signed, which superseded the 1991 IAG. The RFCA established the accelerated action framework, described the goals for cleanup and closure, and defined the regulatory approach for review and approval of work to ultimately de-list the Site from the NPL.
February 4-19, 1996	The soils excavated from Ryan's Pit, a former chemical dumpsite, were treated using a low-temperature process, representing the first onsite treatment of environmental restoration wastes.
August 1996	Excavation and treatment of VOC contaminated soil from Trenches T-3 and T-4 was completed using low-temperature thermal desorption. T-3 and T-4 were used to dispose of sanitary sewage sludge contaminated with uranium, plutonium, and miscellaneous waste.
September 30,1996	Residual contamination in six Underground Storage Tanks is stabilized to prevent potential for contaminate migration.
October 18, 1996	The DOE, CDPHE, and EPA agreed on an interim action level for radionuclide contaminated soils at Rocky Flats. This action level set interim soil cleanup levels based on a dose of 15 millirem per year to a foreseeable land user or to a hypothetical future resident.
April 18, 1997	Workers at the Site completed removal of plutonium, uranium, and solvents at the Mound area, a former waste drum storage area used from 1954 to 1970.
June 30, 1997	The OU 3 CAD/ROD was finalized, concluding that the risk posed by contamination was so low in the four areas in Jefferson County adjacent to

Date	Event
	the Site that no further actions were warranted. The four areas included land east of the Site, Great Western Reservoir, Standley Lake, and Mower Reservoir.
April 25, 1997	Workers at Rocky Flats successfully treated 700 cubic yards of VOC contaminated soil from the Mound Site using low temperature thermal desorption.
October 1, 1997	Approximately two half-crates of contaminated soil from the Mound site were removed after it was determined that it exceeded the soil action level for uranium. Because of an inaccurate mathematical calculation, the soil had been erroneously returned to the Mound site with other treated soils.
May 1998	Building 123 was demolished. Building 123 was the first radiological building demolished at Rocky Flats.
June 15, 1998	Cleanup crews at the Site started the installation of a passive barrier and flow through treatment cell system to treat groundwater contaminants at the Mound Site Plume, an area of shallow groundwater contamination with chlorinated solvents and radionuclides that originated from the Mound site. This treatment system has no moving parts, requires no electricity, and uses recycled materials to clean up contaminated groundwater.
September 30, 1998	Workers at the Site completed the excavation of Trench 1, a former depleted uranium waste burial site.
June 15, 1999	First shipment of TRU waste to the Waste Isolation Pilot Plant
September 28, 1999	Construction of two additional passive groundwater barrier and flow through treatment systems was completed. The systems were installed to treat the East Trenches Plume and the Solar Ponds Plume, which where contaminated from historic site operations.
December 1999	Building 779 demolished. Building 779 was the first major plutonium building demolished at Rocky Flats and in the DOE complex.
December 28, 2001	Rocky Flats National Wildlife Refuge Act signed.

3.0 BACKGROUND

Since the early 1950s, the Rocky Flats Plant played a vital role in the production of nuclear weapons. In the mid-1990s, the Rocky Flats mission changed from production of component parts for nuclear weapons to safe cleanup and closure. RFCA establishes the mechanism for cleanup and closure of the Site. RFCA established the accelerated action framework, described goals for cleanup and closure and, defined the regulatory approach for review and approval of work to ultimately delete the site from the NPL.

Environmental History

The RFCA is a CERCLA Federal Facility agreement and a Resource Conservation and Recovery Act (RCRA) and Colorado Hazardous Waste Act (CHWA) consent order and between the DOE, the Environmental Protection Agency (EPA), and the Colorado Department of Public Health and the

Environment (CDPHE). The RFCA was signed on July 19, 1996 (DOE 1996b). It established the accelerated action framework, described cleanup and closure goals, and defined the regulatory approach for agency review and approval and public participation in cleanup activities intended to ultimately de-list the Site from the NPL. The RFCA replaced the previous 1991 Interagency Agreement (IAG) as the environmental cleanup agreement for RFETS.

Documented areas of soil or water contamination at the RFETS have been designated as Individual Hazardous Substance Sites (IHSSs). Many of these IHSSs have been characterized as part of the Remedial Investigation/Feasibility Study (RI/FS) process, which was conducted under the IAG, (DOE 1991). Several IHSSs have been remediated as accelerated actions in accordance with a Site environmental remediation priority ranking system under either the IAG or RFCA.

The RFCA consolidated the 16 original Operable Units through the Operable Unit Consolidation Plan, RFCA Attachment 1. The Plan creates two large OUs, the Industrial Area OU and the Buffer Zone OU, and retains certain other of the original OUs (see Table 1).

Table 1 - Current OUs as identified in RFCA Attachment 1

OU Number	Description	Lead Regulatory Agency
OU 1	Pre-RFCA OU 1 IHSSs	EPA
OU 3	Pre-RFCA OU 3 IHSSs	EPA
OU 5	Pre-RFCA OU 5 IHSSs except IHSSs 115 and 196 (Original Landfill)	EPA
OU 6	Pre-RFCA OU 6 IHSSs except IHSSs 143 (Old Outfall) and 165 (Triangle Area)	EPA
OU 7	Current OU 7 IHSSs	EPA
Industrial Area OU	All IHSSs from Pre-RFCA OUs 4, 8, 9, 12, 13, 14, IHSSs 115 and 196 from Pre-RFCA OU 5, and IHSSs 143 and 165 from Pre-RFCA OU 6, plus all Pre-RFCA OU 10 IHSSs except IHSSs 170, 174a and 174b (property utilization and disposal yard)	CDPHE
Buffer Zone OU	All IHSSs from Pre-RFCA OU2, and IHSSs 170, 174a, and 174b from Pre-RFCA OU 10.	EPA

RFCA Action Level Framework

The RFCA describes the regulatory framework and approach for performing environmental restoration activities at the Site. Attachment 5 of the RFCA, The Action Levels and Standards Framework (ALF) establishes action levels for groundwater and soil, as well as action levels and cleanup standards for surface water. The Framework action levels describe numeric levels of contamination, identified as Tier I action levels, in groundwater, surface water, and soils. When these action levels are exceeded, they trigger an evaluation, remedial action, and/or management action. Tier II action levels are numeric levels that when exceeded, trigger an evaluation of remedial action and/or institutional controls.

Action levels remain in effect and guide removal actions and other remedial efforts during the period of active remediation. Action levels for non-radionuclide chemicals are risk-based and chemical risk is considered additive when multiple chemicals are present. Radionuclide action levels are dose-based and radiation dose is considered additive when multiple radionuclides are present. Radionuclides and non-radionuclides are assessed independently on a project-specific basis using methodology that is protective of human health and the environment. The cumulative effects of radionuclides and non-radionuclide chemicals will be assessed on a project-specific basis if the chemical risk and/or radiation dose are near their respective Tier I action levels.

The RFCA also describes cleanup levels, put-back levels, and standards. For Accelerated Actions, interim cleanup levels will equal Tier I action levels unless some other ALF provision requires a greater level of cleanup (e.g., protection of surface water).

A standard is an enforceable narrative and/or numeric restriction established by regulation and applied so as to protect one or more existing or potential future uses. Within this framework, standards are associated with surface water, use classifications and are applied at points of compliance (POCs). Standards are not being directly applied to groundwater or soils. Closure performance standards apply to Resource Conservation and Recovery Act (RCRA) units.

Put-back levels are those levels at which excavated soils will be allowed to be returned to the ground. For non-radionuclide chemicals, put-back levels are equivalent to interim cleanup levels. Soils with radionuclide levels below Tier II action levels may be returned; soils containing radionuclide levels above Tier I action levels may not be returned. Decisions regarding soils containing radionuclide levels between Tier I and Tier II will be determined on a case-by-case basis. Because many of the variables used to determine put-back levels are project-specific, put-back level decisions are made and explained within the decision documents associated with those actions. Decision factors to be considered include remedy effectiveness and protectiveness, anticipated future land uses, contaminant levels in surrounding soils, potential for contaminants to affect surface water quality, and costs.

The surface water standards and action levels are based on promulgated state surface water quality standards. The action levels for groundwater are based on the maximum contaminant levels. For those chemical constituents without maximum contaminant levels or standards, groundwater action levels are based on programmatic preliminary remediation goals (PPRGs). PPRGs are chemical-specific and medium-specific risk-based concentrations calculated for an exposure scenario (e.g., office worker, open space recreational user) using Site-specific exposure factors, standard toxicity factors, and a carcinogenic risk level of $1x10^{-6}$, or a hazard index of 1 for non-carcinogenic compounds.

Contaminants of Concern

The major contaminants of concern (COC) for the projects being reviewed in this report are provided in Table 2.

Table 2, Contaminants of Concern

Contaminant Name	OU1	OU3	OU 7 Leachate Seep	T1	T3	T4	Ryan's Pit	Mound	Mound Plume	East Trenches	Solar Ponds Plume	Solar Ponds	IAG UST Source Removals
1,1,1_Trichloroethane (TCA)	X				X	X	X		X	X			
1,1-Dichloroethane							X		X	X			
1,1-Dichloroethene	X				X	X			X	X			
1,2-Dichloroethane					X	X			X				
1,2-Dichloroethene					X	X							
2-Methyl-1-Propene										X			
4-Methyl-2 pentanone							X						
Acetone										X			
Americium (Am)	X	X					X						X
Asbestos				X									
Benzene			X							X			
Cadmium				X									
Carbon Tetrachloride	X				X	X			X	X			
Chloroform					X	X			X	X			
Chloromethane			X										
Cis-1,2-Dichloroethene			X						X	X			

Contaminant Name	OU1	OU3	OU 7 Leachate Seep	T1	T3	T4	Ryan's Pit	Mound	Mound Plume	East Trenches	Solar Ponds Plume	Solar Ponds	IAG UST Source Removals
Cyanide				X									
Depleted uranium (DU)				X									
Ethylbenze			X				X						
Gross alpha													X
Gross beta													X
Methylene Chloride			X						X	X			
Nitrates											X	X	
PCB				X									X
p-Dicholorbenzene									X				
Plutonium (Pu)	X	X					X						X
Propene										X			
Selenium	X												
Semi volatile organics (SVOCs)													X
Tetrachloroethene (PCE)	X		X	X	X	X	X	X	X	X			
Thorium				X									
Toluene			X		X	X	X						
Total metals													X

Contaminant Name	OU1	OU3	OU 7 Leachate Seep	T1	T3	T4	Ryan's Pit	Mound	Mound Plume	East Trenches	Solar Ponds Plume	Solar Ponds	IAG UST Source Removals
Trichloroethene (TCE)	X		X	X	X	X	X	X	X	X			
Tritium				X									
Uranium (U)	X						X	X	X		X	X	X
Vinyl Chloride			X										
Xylene			X				X						

National Wildlife Refuge Act

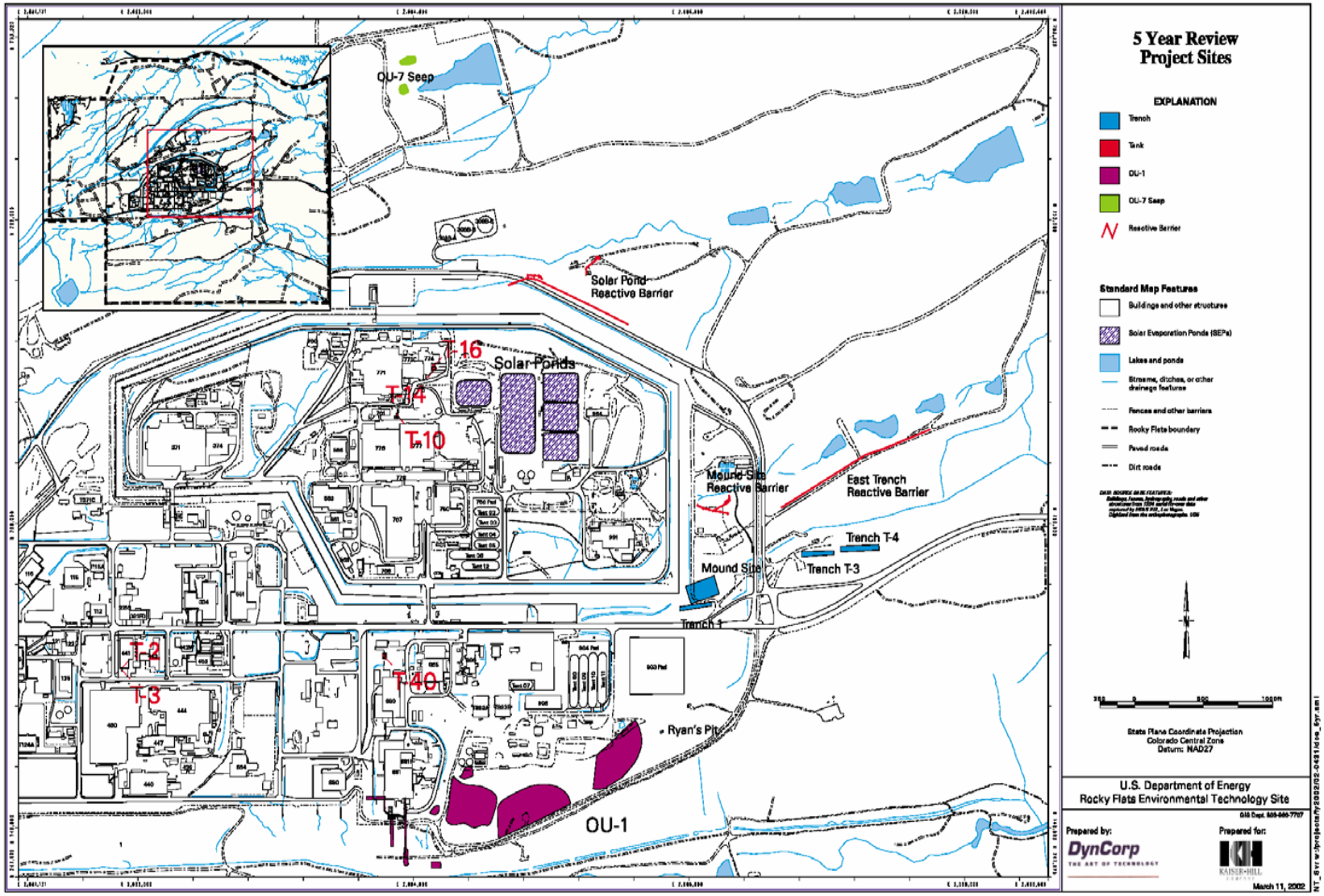
On December 28, 2001, President George W. Bush signed into law the National Defense Authorization Act for Fiscal Year 2002. Subtitle F of this Act is the Rocky Flats National Wildlife Refuge Act of 2001. This Refuge Act provides for the formation of a wildlife refuge on certain lands comprising the Rocky Flats Environmental Technology Site.

4.0 REMEDIAL ACTIONS

This section lists the elements of the remedy for OU 1 and OU 3, provides a discussion of accelerated actions completed through September 30, 2001, and a discussion of NFA/NFRA sites. The projects identified in this section, and the OUs in which they lie, are reflected in Table 3 below and in Figure 1.

Table 3

Project	**Consolidated OU Involved**	**IHSSs Involved**
OU 1	OU 1	102, 103, 104, 105.1, 105.2, 106, 107, 119.1, 119.2, 130, and 145
OU 3	OU 3	199, 200, 201, 202, land surfaces, and reservoirs
OU 7 Leachate Seep	OU 7	
Trench 1	Buffer Zone	108
Trench 3	Buffer Zone	110
Trench 4	Buffer Zone	111.1
Ryan's Pit, Trench T-2	Buffer Zone	109
Mound Site	Buffer Zone	113
Mound Plume	Buffer Zone	
East Trenches Plume	Buffer Zone	
Solar Ponds Plume	Industrial Area	176
Solar Ponds	Industrial Area	101
IAG UST Source Removals	Industrial Area	Tank-10(IHSS Group 700-3), Tank-2 (IHSS Group 400-8), Tank-3 (IHSS Group 400-8), Tank-40 (IHSS Group 800-6), Tank-16 (IHSS Group 700-4), Tank-14 (IHSS Group 700-4)


OU-7 Seep
Solar Pond Reactive Barrier
T-16
Solar Ponds
T-14
T-10
Mound Site Reactive Barrier
East Trench Reactive Barrier
Trench T-4
Trench T-3
Mound Site
Trench 1
T-2
T-3
T-40
Ryan's Pit
OU-1
5 Year Review Project Sites
EXPLANATION
Trench
Tank
OU-1
OU-7 Seep
Reactive Barrier
Standard Map Features
Buildings and other structures
Solar Evaporation Ponds (SEPs)
Lakes and ponds
Streams, ditches, or other drainage features
Fences and other barriers
Rocky Flats boundary
Paved roads
Dirt roads
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27
U.S. Department of Energy
Rocky Flats Environmental Technology Site
Prepared by:
DynCorp
Prepared for:
March 11, 2002

4.1 Remedy Selection-Operable Unit 1, 881 Hillside

Background

OU 1, also known as the 881 Hillside, was comprised of eleven IHSSs, all of which are located generally south and east of Building 881 and north of Woman Creek. Based on monitoring results, the primary COCs in groundwater at OU 1 are volatile organic compounds (VOCs) that leaked from drums and scrap metal that was stored in the area referred to as IHSS 119.1. These COCs include carbon tetrachloride, 1,1-dichloroethene, tetrachloroethene, 1,1,1-trichloroethane, trichloroethene (TCE), and selenium.

The OU 1 Interim Measure/Interim Remedial Action (IM/IRA) Action Plan and Decision Document was submitted to EPA in January 1990 (DOE 1990). The specific objectives stated in the OU 1 IM/IRA Decision Document are:

1 Contain, reduce, and/or eliminate site contaminants identified as posing potential threats to human health or the environment;
2 Reduce or eliminate exposure to site contaminants for potential receptors by controlling potential contaminant pathways;
3 Demonstrate technical feasibility and environmental and cost effectiveness of the interim remedial action.

During 1992, construction was completed for the OU 1 IM/IRA French drain to contain, collect, and treat contaminated groundwater from the upper hydrostratigraphic unit in order to prevent its migration downgradient and to protect the water quality of Woman Creek. The Consolidated Water Treatment Facility, Building 891, was also completed during 1992.

The OU 1 IM/IRA consists of:

1 A subsurface French drain, approximately 1,435 feet long that is keyed into bedrock across a portion of the hillside upgradient of Woman Creek;
2 A collection well in the center of the groundwater plume;
3 The Building 891 Consolidated Water Treatment Facility;
4 Groundwater monitoring wells downgradient of the French drain.

Groundwater collected by the French drain was pumped from a central sump through subsurface piping to the Building 891 Consolidated Water Treatment Facility. Groundwater from the collection well, which is a 3 foot diameter sump into which groundwater flows passively, is pumped to a portable tank that is trucked to the same facility for treatment on a weekly basis. Originally this treatment facility used only two processes to remove contaminants from the groundwater collected from OU 1: ultraviolet light/hydrogen peroxide oxidation for VOCs; and ion exchange for metals. In 1996 other treatment processes were added, and since then, contaminated remediation waste water from other sources at Rocky Flats are also treated at this facility. After verification of treatment, the water is discharged to the South Interceptor Ditch.

Subsequent to the implementation of the OU 1 IM/IRA, the phase three remedial investigation was completed and concluded that only IHSS 119.1 contained a significant source of contamination in the subsurface soil and groundwater. The other IHSS's were not found to be contamination source areas, do not contribute significantly to groundwater contamination and do not warrant any further remedial action (Final RFI/RI, DOE 1994a).

In February 1997, a CAD/ROD for OU 1 (DOE 1997b) was signed for the purpose of addressing the contamination at IHSS 119.1 through soil excavation and groundwater pumping. The Remedial Action Objectives set for OU 1 are as follows:

1 Prevent the inhalation of, ingestion of, and/or dermal contact with VOCs and inorganic contaminants in OU 1 groundwater that would result in a total excess cancer risk greater than 10^{-4} to 10^{-6} for carcinogens, and/or a Hazard Index greater than or equal to one for non-carcinogens;
2 Prevent migration of contaminants from subsurface soils to groundwater that would result in groundwater contamination in excess of potential groundwater Applicable or Relevant and Appropriate Requirements (ARARs) for OU 1 contamination;
3 Prevent migration of contaminants in OU 1 groundwater from adversely impacting surface water quality in Woman Creek.

Major Modification to OU 1

A post CAD/ROD investigation of subsurface soils at IHSS 119.1 was conducted in order to better delineate the remaining source of contamination. Details of the sampling can be found in the *Sampling and Analysis Plan for the Implementation Sampling for the IHSS 119.1 Source Removal Project* (RMRS 1997a). Analytical results of subsurface soils samples collected in the area of contamination did not exceed the RFCA Tier I action levels for subsurface soils. The results of the sampling can be found in the *Post-CAD/ROD Investigation Report for the 881 Hillside Area, IHSS 119.1* (RMRS 1997b). A summary of the results can be found in Table 4 below.

Table 4 RFCA Tier 1 Subsurface Soil Action Levels IHSS 119.1 and Downgradient

COC	Action Level (MG/KG)	IHSS 119.1 Sampling FOD	IHSS 119.1 Sampling Results (MG/KG)	Downgradient Investigation FOD	Downgradient Investigation Sampling Results (MG/KG)
Carbon Tetrachloride	3.56	0/38	0.062 U	0/13	0.62 U
1,1-Dichlorethene	2.19	2/38	0.17J-0.23J	0/13	0.62 U
Tetra-Chloroethene	3.15	3/38	0.16J-0.66	0/13	0.62 U
111-Trichloro-ethane	94.8	2/38	0.16J-0.28J	0/13	0.62 U
Trichloro-Ethene	3.28	2/38	0.34J-0.55J	0/13	0.62 U

FOD=Frequency of Detection represents the number of detection's/number of samples
U=COC was not detected at that level
J=Estimated concentration at the level indicated. The concentration represents a value below detection limit

In January 2001, a major modification to the CAD/ROD was amended and signed to eliminate the excavation of soils due to the contaminants being either non-detectable or present at only very low concentrations (DOE 2001a). Institutional controls will be used to prevent the use of any groundwater on site and groundwater monitoring will continue in order to ensure that the plume is not migrating toward Woman Creek. Operation of the collection well is to continue for one year after the major modification to the CAD/ROD was signed (February 23, 2001). At that time, if data from four quarters of monitoring shows an average concentration for trichloroethene to be below the ALF Tier I action level then pumping and treating of groundwater will be discontinued. (Based on recent monitoring results, pumping and treating of groundwater was discontinued in April 2002.) The collection well will then be designated as a Plume Definition Well and initially monitored quarterly consistent with the Integrated Monitoring Plan (IMP). Consistent with the original remedy, groundwater monitoring will be performed in accordance with the IMP after completion of groundwater pumping through Site Closure with evaluation occurring during subsequent CERCLA Five-Year Reviews. Long term monitoring beyond Site Closure will be established as appropriate in the Final Site CAD/ROD.

As part of the original CAD/ROD, decommissioning of the French drain is separate from the Modified Remedy and was accomplished in September 2000. The French drain system was breached at the lowest point and the collected groundwater now flows underground through a conveyance to the South Interceptor Ditch. Water quality of groundwater collected by the French drain has been sampled quarterly since 1993 and data indicate contaminant concentrations have been consistently below ALF Tier II groundwater action levels. Monitoring will continue in accordance with the IMP to ensure groundwater is not impacting surface water quality in Woman Creek.

4.2 Remedy Selection Operable Unit 3, The Offsite Areas

Background

OU 3 was established to address Site-related contamination-transport offsite by wind and water. OU 3 was the only original IAG Operable Unit not located on Rocky Flats property. RFCA consolidated most of the OUs at RFETS. OU 3 remained separate under RFCA, owing to its unique geographic location and the fact that investigations and administrative actions for OU 3 had been nearly completed at the time the RFCA was signed.

OU 3 did not have a defined boundary, but rather referred to offsite contamination emanating from Rocky Flats in general. OU 3 is comprised of four IHSSs: Contamination of the Land Surface (IHSS 199), Great Western Reservoir (IHSS 200), Standley Lake (IHSS 201), and Mower Reservoir (IHSS 201). DOE performed extensive environmental investigations in OU 3 in the early 1990s, taking samples of surface soils, reservoir sediments, surface water, and groundwater. The results of these investigations appear in the RCRA Facility Investigation/Remedial Investigation (RFI/RI) Report for Operable Unit 3, submitted in final form to EPA and CDPHE on July 11, 1996 (DOE 1996a). In addition to summarizing the results of environmental investigations in OU 3, the RFI/RI Report contained a Baseline Risk Assessment, which in turn contained an assessment of the human health risks posed by the contaminants found in OU 3, called the Human Health Risk Assessment (HHRA).

Based upon the RFI/RI Report's evaluations of sampling data, DOE, EPA and CDPHE selected COCs for OU 3. COCs are those substances that may contribute significantly to human health risks, and which were considered in the HHRA. Plutonium and americium (a radioactive decay product of plutonium) were the COCs selected for OU 3. The highest level of plutonium found in OU 3 was approximately 6.5 picoCuries per gram (pCi/g), found in a surface soil sample about 1,800 feet east of the intersection of the RFETS East Access Road and Indiana Street. The highest level of americium encountered was approximately 0.5 pCi/g, in a surface soil sample just east of the intersection of the East Access Road and Indiana Street. The highest levels of these two contaminants were lower in reservoir sediments than in surface soils. The RFI/RI Report concluded that windblown dispersal of contaminants from leaking drums stored on the 903 Pad was the primary source of plutonium and americium in OU 3 surface soils and most reservoir sediments. The RFI/RI report concluded that waterborne transport was the most important source of contamination in sediments in Great Western Reservoir.

The HHRA evaluated the risks posed by these contaminants. For all of OU 3, the highest calculated excess cancer risk was three in one million ($3x10^{-6}$), using reasonable maximum exposure for a residential scenario. Using the recreational scenario and a reasonable maximum exposure, the highest calculated excess cancer risk was one in one hundred million ($1x10^{-8}$). The primary reason for the differences in risk is the difference in time spent at the Site in the two scenarios. EPA guidelines indicate that excess lifetime cancer risks which are within or below the one in ten thousand ($1x10^{-4}$) to one in one million ($1x10^{-6}$) range are protective of human health. All calculated risks for OU 3 were well within or well below this range.

DOE submitted the OU 3 RFI/RI Report to the Agency for Toxic Substances and Disease Registry (ATSDR), a part of the Federal Centers for Disease Control, to obtain a Health Consultation. The Health Consultation provided an independent evaluation of whether COCs had been adequately identified, the risks to human health posed by the COCs in OU 3, and whether the proposal for no further action in OU 3 was appropriate. The ATSDR concluded that the COC selection process was reasonable and that none of the constituents in OU 3 posed public health concerns. The ATSDR Health Consultation also stated that no additional activities were needed in OU 3 to protect public health (DOE 1997c).

Based upon the risks calculated in the RFI/RI, the OU 3 CAD/ROD selected a remedy of no action. The Declaration Statement in the OU 3 CAD/ROD reads as follows :

"DOE, in consultation with CDPHE and EPA, has determined the no remedial action is necessary for OU 3 to be protective of human health and the environment. No hazardous substances, pollutants or contaminants will remain within the boundaries of OU 3 above levels that allow for unlimited use and unrestricted exposure, as these levels have been calculated in the OU 3 RFI/RI Report. Since no national health-based standards have been promulgated for the radioactive contaminants remaining in OU 3, this Corrective Action Decision/Record of Decision will be reviewed in five years, consistent with CERCLA Section 121(c), to ensure consistency with such a national standard, if one is later promulgated."

Since the conclusions contained in this CAD/ROD are in part dependent on calculated radiation exposure levels, the CAD/ROD will additionally be reviewed if necessary, consistent with CERCLA Section 121(c), to ensure consistency with any revisions to those calculated levels that may result from new regulations, or improved calculation methods or modeling parameters.

The OU 3 CAD/ROD became final during May 1997.

4.3 Trench T-1 Source Removal

Background

The remediation of Trench 1 (T-1) at RFETS was conducted during the period of June 1998 through August 1998. The T-1 site is located northwest of the inner east gate, about 40 feet south of the southeast corner of the protected area fence. The trench was expected to be 200 feet long, 15 to 20 feet wide, and 10 feet deep. Historical documentation indicated that depleted uranium metal chips (lathe and machine turnings) originating from Building 444 were packed with lathe coolant and buried in the west end and possibly the east end of T-1 in approximately 125 drums. Ten drums of cemented cyanide and one drum of "still bottoms" (recovered waste solvents or evaporated lathe coolant sludge) were also suspected to have been buried in T-1 along with an unknown amount of debris. The still bottoms could have potentially consisted of still bottoms from the recovery of residual trichloroethene and perchloroethene waste solvents and sludge generated from machined parts cleaning. Consequently, the primary COCs were depleted uranium (DU), cyanide, and possible trichloroethene and perchloroethene.

Evaluation and characterization of the environmental conditions in the vicinity of T-1 was conducted using available data compiled from the OU 2 Phase II RFI/RI report (DOE1995a) and the Draft Trenches and Mound Site Characterization Report (RMRS 1996a). Subsurface soil and groundwater data evaluated included analytical results from three boreholes and five groundwater monitoring wells installed near the west portion of T-1. In addition, a limited soil gas survey was performed at the trench site to screen for VOCs. Electromagnetic and ground penetrating radar surveys were conducted at the site in 1995 to locate buried conductive objects and define the trench boundaries. Based on the characterization data available there did not appear to be significant subsurface soil or groundwater contamination with a source in T-1. (RMRS1998a)

Project Description

The project was authorized via the Proposed Action Memorandum (PAM) for the Source Removal at Trench 1, dated March 5, 1998 (RMRS 1998a). The objectives of the removal were to: 1) remove all drummed wastes and debris from the trench; 2) remove all contaminated soil exceeding RFCA Tier I action levels for radionuclides, VOCs and cyanide, and; 3) disposition contaminated soils, drummed waste and debris.

One hundred seventy one drums or containers were removed from T-1 during excavation activities. Several waste streams were generated from the source removal including radioactive metal wastes, cemented cyanide wastes, contaminated soils, decanted lathe coolant, and debris. Intact drums containing depleted uranium and cemented cyanide were removed from the trench,

preliminary characterization was conducted, and the drums were placed in over-pack containers. Other than drum carcasses, very little debris was encountered during the T-1 excavation. Several conditions were encountered during excavation that caused a temporary pause in operation including rapid oxidation of depleted uranium (DU), the discovery of uranium hydride potentially containing tritium, and asbestos within the cemented cyanide matrix. These issues were resolved and removal activities resumed.

When the removal was completed, approval was obtained from the EPA to use the soils contained in 1,434 stored drums of Investigative Derived Material (IDM) (soil that was generated during past remedial investigation drilling activities across the Site) as backfill. All IDM material placed in T-1 was well below Tier II action levels. The site was demobilized, including removal of the tent structure used to protect the remediation from the elements, and the area was graded and seeded.

Some of the waste generated was shipped to the Nevada Test Site or to Envirocare for disposal. The largest mixed waste stream requiring treatment was the depleted uranium contained in eighty 83-gallon drums, forty-nine 110-gallon drums and twenty-three B-12 metal crates. The depleted uranium waste stream is considered contaminated with chlorinated VOCs, cadmium, and PCBs. The containers are currently being stored in a RCRA storage unit on the 904 Pad. The treatment options proposed in the PAM are not feasible, and alternatives are being investigated. An evaluation of treatment alternatives for the T-1 wastes is included in the Trench 1 Waste Characterization and Disposition Pathways Analysis Report, (RMRS 1999a).

4.4 Trench 2, Ryan's Pit Source Removal

Background

Ryan's Pit, also know as Trench 2, was used from approximately 1966 to 1970 for the disposal of VOCs and small quantities of debris (e.g. drum carcasses). The site is located south of the 903 Pad and was approximately 32 feet long and 18 feet wide. The results of environmental investigations, conducted between 1992 and 1995, identified Ryan's Pit as a significant contributor to the contamination of groundwater in this area. The primary chemicals of concern at Ryan's Pit included 1,1,1-trichloroethane (1,1,1 TCA), tetrachloroethane (PCE), and trichloroethene (TCE). No disposal of radiological wastes was suspected.

Project Description

The remedial accelerated action objectives of the source removal action were to: 1) remove all VOC contaminated soil and debris from the trench, 2) treat the soil and debris with an on-site thermal desorption unit, and 3) backfill the excavation with the treated soils.

The Final PAM for the accelerated action of IHSS 109, Ryan's Pit, dated August 24, 1995 (RMRS 1995a), authorized the project. During final reviews of the PAM, CDPHE determined that the on-site treatment of the Ryan's Pit soil would require a modification to the Rocky Flats Part B Hazardous Waste Operating Permit. The Permit modification established basic operating parameters for the onsite storage and treatment of soils excavated from the trench and established performance standards for the treatment of VOC contaminated soils (RMRS 1995b).

Soil excavation was conducted between September 5 and September 12, 1995, in accordance with the PAM/Permit Modification. A track-mounted backhoe excavated approximately 180 yd^3 of contaminated soil and debris, which was placed in nine roll-off boxes and covered. The roll-off boxes containing the contaminated trench soils were subsequently sampled for metals and radionuclides. Samples from six of the nine roll-off boxes indicated radionuclide levels exceeding the Programmatic Preliminary Remediation Goals (PPRG) criteria established by the PAM. As a result, return of the soil following processing for VOCs was delayed pending further radionuclide evaluation. The sum of the radionuclides excess cancer risk was reevaluated and determined to be 8.1×10^{-6}. A PAM modification described the risk evaluation and stated that since the risk was still within the EPA's acceptable range of lifetime cancer risk to an individual, return of the soil to the trench was acceptable (RMRS 1996b). Soil was treated using low temperature thermal desorption between February 4 and February 19, 1996. (A summary of treatment results can be found in section 8.3.4.) On September 16 through September 17, 1996, the treated soil was returned to Ryan's Pit and was covered with the original, untreated topsoil. On September 30, 1996, the site was seeded with native grass seed and covered with a stabilization material to hold the seed in place.

4.5 Trenches T-3 and T-4 Source Removal

Background

Trenches T-3 and T-4 were used to dispose of sanitary sewage sludge contaminated with uranium and plutonium and miscellaneous waste. Flattened empty drums contaminated with uranium and plutonium were also disposed in the trenches. Based on monitoring results, trenches T-3 and T-4 were sources of VOC contamination in the groundwater. Upgradient and downgradient wells were sampled and results are summarized in the PAM dated March 28, 1996 (DOE 1996c). The results showed a significant increase in VOC concentrations in downgradient wells. VOC contaminants include carbon tetrachloride, PCE, TCE, and toluene.

Trench T-3 was used from approximately October 1964 through April 1966. Trench T-4 was used from approximately April 1966 through April 1967. They were both constructed by bulldozing to a depth of approximately ten feet. The dimensions of T-3 were approximately 20 feet by 134 feet while T-4 was approximately 20 feet by 125 feet. The trenches are located north of the east access road and east of the north east perimeter road.

Project Description

The purpose of the Trenches T-3 and T-4 accelerated action was to remove the source of VOC contamination from the trenches. The project was authorized by the PAM for the Source Removal at Trenches T-3 and T-4, Revision 2, dated March 28, 1996 (DOE 1996c). Approximately 3,796 cubic yards of contaminated soil and debris were removed from the trenches and processed using thermal desorption to remove VOCs, primarily carbon tetrachloride, TCE, and PCE. The excavation of T-3 was approximately 136 feet long, 18 to 24 feet wide, and 15 feet deep, and it included 1,706 cubic yards of material. The excavation was completed July 3, 1996, and the treatment of T-3 material was completed July 11, 1996. The

excavation of T-4 was 148 feet long, 19 to 22 feet wide and approximately 12 feet deep, except where the excavation proceeded to bedrock at 26 feet. The amount of material excavated from T-4 was approximately 2,090 cubic yards. The excavation was completed August 14, 1996, and the treatment of T-4 material was completed August 19, 1996.

The primary objective of the project was to remove VOC source material; however, radiocuclide contamination was screened as part of the project as well. All soil, including the material initially segregated as potentially radionuclide contaminated met the RFCA ALF Tier I subsurface action levels, dated May 30, 1996. Furthermore, all but approximately 250 cubic yards of soil met the Tier II values as well. Consequently, all treated soil was returned to the excavation. The 250 cubic yards of soil between Tier I and Tier II was wrapped in a burrito wrap with its location noted in the event it becomes necessary to remove this soil in the future. The Tier I action levels used for the T-3/T-4 project are shown in table 5 below. A sum of the ratios calculations was used to determine that soil met the Tier I action level.

Table 5 Tier I Action Level for Residential Exposure Used for the T-3/T-4 Project

Radionuclide	Action Level (pCi/g)
Americium–241	229
Plutonium-238	2140
Plutonium-239	2001
Plutonium-240	2007
Plutonium-241	21530
Uranium-234	2042
Uranium-235	136.8
Uranium-238	613.9

In addition to the soil that was excavated, debris, including approximately 300 drum carcasses, was removed from T-3/T-4. These drum carcasses were segregated according to activity levels prior to managing them as waste. To improve waste packaging efficiency some of the carcasses were size reduced using a track hoe bucket. During this size reduction evolution approximately two pounds of depleted uranium was spilled. The spill resulted in activation of the Emergency Operations Center and spill cleanup.

4.6 Source Removal at the Mound Site, IHSS 113

Background

An excavation and source removal of VOCs from soil was conducted at IHSS 113, the Mound Site, in 1997. The Mound Site is located north of Central Avenue, and east of the Industrial Area fence. Between 1954 and 1958, drums containing uranium, beryllium, hydraulic oil, carbon tetrachloride and PCE were stored at the Mound Site. Approximately 1,405 intact drums were placed at the Mound Site and covered with soil; creating a mound. The drums originated from Buildings 444, 883, 771, and 776. Prior to the removal of the drums in 1970, some of the drums were known to have leaked, and the resulting contamination began impacting groundwater. In 1970, all drums were removed from the Mound Site along with some radiologically contaminated soil.

Performance monitoring well data downgradient of the Mound Site was evaluated to determine if a trend in the concentration is occurring. Groundwater data from the 2000 Annual Rocky Flats Cleanup Agreement Groundwater Monitoring Report was evaluated for this report (KH 2001c).

Project Description

A Final PAM was authorized for the excavation and removal of the VOCs, dated February 1997 (RMRS 1997c). The proposed action objective of the accelerated action was to excavate and thermally treat VOC-contaminated soils from the Mound Site, thereby preventing further degradation of groundwater and to protect human health and the environment. The subsurface soils at the Mound Site contained substantially higher concentrations of VOCs than the surrounding area. This action involved excavating approximately 400 to 1,000 cubic yards of soil from the site using standard excavating equipment. The soil was temporarily stockpiled, then was treated using a low temperature thermal desorption remediation technology. Treated soil was then used as backfill into the excavation.

The low temperature thermal desorption system used for the Mound Site project was an improved system over what was used in the T-3/T-4 project. The treatment system was re-engineered by moving the HEPA filters further down the air flow path to minimize any moisture that could impinge on them. The treatment beds were also re-engineered to minimize the amount of water required for cooling.

Approximately 725 cubic yards of soil were contaminated with VOCs above the Tier I subsurface action levels specified in Attachment 5, The Action Levels and Standards Framework for Surface Water, Groundwater, and Soils, of RFCA. The contaminated soil was excavated from the Mound Site, and successfully treated using low temperature thermal desorption to remove the VOC contamination. The Mound Site contaminants of concern included PCE, TCE, methyl chloride, and carbon tetrachloride. The treated soils were backfilled to the Mound Site between September 3 and 8, 1997, and the area was restored and re-vegetated. A closeout report was written in October 1997 (RMRS 1997d).

As part of the backfill operation, three partially filled 55-gallon drums of soil were emptied into the bottom of the Mound Site excavation. This soil originated as a remnant from the T-3/T-4 project. Initial results indicated that the soil was below the RFCA Tier II subsurface soil action levels for radionuclides. As a result, a determination was made to place this soil in the Mound Site excavation. After placement of the soil and backfilling was complete, it was determined that the initial analyses were in error, and re-analysis indicated that the soil was above the Tier I subsurface soil action levels. A decision was then made to exhume this soil. Approximately 3 cubic yards of soil was removed from the excavation on September 26, 1997. Project Radiation Control Technicians identified the “hot spot” soil using visual inspection and a Field Instrument for the Detection of Low Energy Radiation (FIDLER) and samples were collected for gross alpha/beta analyses below the hot spot location. Results of these samples are contained in Appendix C of the Closeout Report (RMRS 1997d).

4.7 Mound Plume Accelerated Action

Background

The Mound Site Plume project is located north of Central Avenue and east of the RFETS Industrial Area along the southern edge of the South Walnut Creek Drainage. The Mound Site was a drum storage area where 1,405 drums of uranium and beryllium contaminated lathe coolant (a mixture of approximately 70% hydraulic oil and 30% carbon tetrachloride) were placed between 1954 and 1958. Some drums also contained PCE. Historical information also indicates that some of the coolant contained low levels of plutonium (DOE 1992). The drums were removed in 1970, but 10% of the drums were suspected to have leaked. However, there are no records of the volume of contaminants released to the soil at the Mound Site. Radioactively contaminated soils were removed at the time the drums were removed from the Mound Site and removal of VOC contaminated soil was completed as an accelerated action in 1997, as described in Sections 4.6 and 8.3.6 of this report.

Performance monitoring well data downgradient of the Mound Site was evaluated to determine if a trend in the concentration is occurring. Groundwater data from the 2000 Annual Rocky Flats Cleanup Agreement Groundwater Monitoring Report was evaluated for this report (KH 2001c).

The ground surface slopes steeply to the north from the Mound Site towards the incised drainage of South Walnut Creek. VOC contaminated groundwater is found in monitoring wells between the Mound Site and South Walnut Creek, which indicates that the Mound Site is the primary source area for the plume. While thirty-five VOCs have been detected in the plume, PCE and TCE are the dominant contaminants. PCE is the predominant contaminant with historical concentrations as high as 528,000 micrograms/liter (ug/l) found in well 0174 at the Mound Site while the highest TCE concentration detected was 18,000 ug/l. Concentrations of these chemicals decrease towards South Walnut Creek; however, groundwater samples collected confirm that VOC contaminated groundwater is present in localized areas near the South Walnut Creek Drainage.

Project Description

The Mound Site Plume project was conducted in accordance with the Mound Site Plume Decision Document (DOE 1997d). The project was a cooperative effort between the RFETS and the DOE Subsurface Contaminant Focus Area, with support from the National Risk Management Research Laboratory of the EPA.

The project had the following objectives:

- Intercept and treat contaminated groundwater, including seep SW059, at the distal end of the Mound Site Plume.
- Design and install a passive groundwater treatment system that, to the extent practicable, protects surface water and reduces the contaminant mass loading in surface water consistent with the ALF.

- Design the reactive metals treatment system and the barrier wall construction method to minimize the generation of low-level mixed waste and/or low-level waste.
- Design the reactive metals treatment system for easy access for operation and maintenance and for ease in media replacement or final removal.
- Develop cost and performance data for design of low cost and effective treatment systems.
- Minimize the impacts to the Prebles Meadow Jumping Mouse during construction by installing silt fences between the construction area and the creek to prevent downstream sedimentation of habitat.
- Avoid depletion of waters to South Walnut Creek.

The Mound Site Plume Project employs a groundwater barrier/collection and iron filings treatment system to remove chlorinated organic compounds and low levels of radionuclides. The single-membrane, impermeable containment barrier consists of high-density polyethylene (HDPE) that extends approximately 230 feet across the distal portion of the plume.

Five monitoring points were installed in the collection trench for performance monitoring of the system. The sump is piped to two treatment cells located downgradient of the barrier and collection system. Zero-valent iron in two sub-grade treatment cells is used to dehalogenate the VOCs and radionuclides to below the Tier II Action Level Framework levels concentrations as defined in RFCA. Radionuclides in the groundwater are removed by chemical reduction and/or adsorption and remain on the iron matrix. Most of the contaminants are destroyed or removed within the first two feet of the iron medium in the first cell. The remaining contaminants are destroyed or removed before the water leaves the cell. The treatment cells were designed so that treatment medium can be easily removed and retrieved to allow the extraction of bound contaminants and replenishment of the reactive medium. Treated water is discharged back into the groundwater on the downgradient side of the treatment cells through a discharge gallery, similar in construction as a French drain but working in the opposite direction.

Installation of the collection and treatment system was completed on September 18, 1998. The EPA Superfund Innovative Technology Evaluation program began effluent sampling on October 28, 1998 after it was agreed that much of the tap water placed in the reactor vessels during construction and start up activities had been displaced by contaminated groundwater.

4.8 East Trenches Plume Accelerated Action

Background

As a result of past waste storage practices at the East Trenches, VOCs are present in groundwater in excess of the ALF Tier I level groundwater concentrations defined in the RFCA. The plume of VOC contaminated groundwater is derived from the East Trenches area, which includes Trench T-3 (IHSS 110) and T-4 (IHSS 111.1). These disposal trenches were used between 1964 and 1967 for disposal of sanitary sewage sludge contaminated with low levels of uranium and plutonium, VOCs, and miscellaneous waste. These trenches were excavated as part of an accelerated source removal action in 1996, as described in Sections 4.5 and 8.3.5.

A component of the plume may also be derived from the VOC contamination at the 903 Pad where drums containing plutonium and uranium contaminated oils and solvents were stored from the summer of 1958 to January 1967.

The primary contaminants in the East Trenches groundwater plume are VOCs derived from the Trench 3 and Trench 4 source areas. VOC contamination was detected in the groundwater and in seeps at South Walnut Creek. In the source area, semi-volatiles, petroleum hydrocarbon compounds, and uranium-238 at concentrations up to 3,240 pCi/g were also detected in the soils (RMRS 1996a). At the collection system location, TCE was the predominant contaminant found in groundwater with the highest concentration of 6,800 micrograms/liter (μg/l) in well 23197. The other major contaminants included 1,1-trichloroethane at 730 μg/l in well 22697, and carbon tetrachloride at 460 μg/l in well 22997.

Project Description

The East Trenches Plume accelerated action project was conducted in accordance with the Final PAM for the East Trenches Plume (DOE 1999a). A groundwater collection and treatment system was installed to capture, redirect, and treat contaminated groundwater within treatment cells containing zero-valent iron. System installation began in February 1999 and was completed on September 23, 1999. The collection system was the last component completed.

As defined in the PAM, the objectives of this accelerated action were:

- Intercept and treat VOC-contaminated groundwater at the distal (northern) end of the East Trenches Plume. (The COCs and their respective RFCA Tier II action levels for groundwater are listed in the Table 11 found in section 8.3.8.)

- Protect surface water and reduce the VOC-contaminant mass loading in surface water, to the extent practicable.

- Install an easily accessible system to reduce operation and maintenance costs and to easily replace media when necessary.

- Minimize the impact to Preble's meadow jumping mouse during construction.

- Avoid depletion of waters to South Walnut Creek.

The groundwater collection system extends approximately 1,200 feet in an east-west direction and captures the majority of the contaminated groundwater plume. A collection sump was installed at the eastern end of the collection system to accumulate groundwater, and to allow fine-grained sediment to drop out. The collected groundwater flows by gravity from the collection sump through a 2-inch, non-perforated HDPE conveyance line to the two treatment cells.

The treatment system consists of two high-density polyethylene tanks containing reactive iron, which degrades the dissolved chlorinated VOCs in the groundwater. The system utilizes iron to induce conditions where hydrogen is substituted for chlorine in the chlorinated VOCs. The end

products of the process are completely dehalogenated hydrocarbons and non-toxic salts. The treatment cells are approximately 12 feet in diameter and 13 feet tall. Groundwater enters the cells at the top and percolates through the 6.5 feet of iron. There is one foot of granular material on the bottom of each treatment cell to disperse the groundwater. The upper foot of each cell is a 50/50 mixture of iron and pea gravel to simplify mechanical break-up of the expected crust formation.

The treatment cells are piped so that they can be run in serial or parallel. Water discharges from the base of the treatment cell to the next cell or to the metering manhole. The metering manhole contains a water flow meter to determine the volume of water treated, and is the effluent sample location. From the metering manhole, the treated water then discharges to groundwater through an infiltration gallery located adjacent to South Walnut Creek. However, for additional flexibility, the system allows discharge directly to surface water in South Walnut Creek, if needed. Reclamation of the disturbed areas and restoration of the B-Series Pond road took place after installation of the collection and treatment system.

Four downgradient monitoring wells monitor the performance of the system. One existing well is being used along with three additional wells installed as part of the project.

Minor modifications were made to the design as presented in the East Trenches Plume PAM. One minor field modification to Section 5.2.5-Construction Waters, was made to allow construction waters at the East Trenches Plume Project to be discharged to the B-Series Ponds. This was a safety measure for occasions when large quantities of water generated during construction could not be effectively or safely be collected and transferred to the Site's Consolidated Water Treatment Facility. Water was primarily discharged to Pond B-2, however some water was also transferred to Pond B-1 to maintain a sufficient quantity of water in that Pond. The other modification involved deleting the geotextile fabric around the filter pack in the collection trench when it was found to be unnecessary.

4.9 Solar Pond Plume Accelerated Action

The five SEPs are located in the northeastern portion of the Industrial Area, and were used to process the site’s liquid waste streams from 1953 to 1986. Three previous ponds were located at or in the immediate vicinity of the current 207C Pond. Two of these ponds were constructed in 1953. The ponds were utilized, emptied and removed from operation in 1956 for the installation of clay liners following completion of the current 207A Pond. The ponds were returned to operation later that year. The third original pond was constructed in 1959 to contain potential overflow from 207A. The three original ponds were removed from service in 1960 when the B Series Ponds commenced operation. The southernmost of the original ponds was re-graded for the construction of B-779 in 1962. The other two original ponds were re-graded and are now the site of the current 207C Pond constructed in 1970. The current five ponds were emptied and relined several times since their construction. Resultant wastes were shipped offsite for disposal during the relining operations.

Operation of the SEPs resulted in contamination of the underlying and adjacent soils and shallow groundwater with nitrates and uranium. The solar pond plume (SPP) is a discontinuous area of

groundwater contamination that extends northeast from the SEPs to the North Walnut Creek and southeast towards South Walnut Creek. Various remediation and closure activities have been conducted over the years to mitigate releases from the SEP. Past remedial activities include pond relining/repairs, removal of water and sludge from the ponds, and construction of groundwater interceptor ditches and trench systems. The primary contaminants associated with the plume are uranium and nitrate.

A series of ditches with associated water collection and pumping equipment was installed in seeps along the hillside north of the ponds beginning in 1970. Seeping groundwater was collected from the ditches and pumped backed into pond 207B North. A much more extensive interceptor trench system (ITS) was constructed in 1981. Contaminated groundwater collected by the ITS was pumped back uphill from the ITS pump house near Walnut Creek into Pond 207B-North. Three temporary modular storage tanks were constructed on the hillside to the northwest of the ITS pump house in 1992 to contain the water collected by the ITS. These tanks were brought on line in 1993 at the same time that piping modifications were made in the pump house sump and Building 910 to accommodate direct transfer of water from the temporary modular storage tanks to Building 374 for treatment by evaporation.

The current SPP collection and treatment system was installed and placed into operation in 1999. This new system replaces the previous temporary modular storage tanks and B-374 evaporation treatment systems. The SPP system collects water primarily from the old ITS, passes it through a two stage treatment cell containing iron filings and wood chips, and discharges to a gallery near Walnut Creek as described below.

Project Description

The current SPP collection and treatment system was installed as an IM/IRA in 1999 (DOE 1999b). The objectives of the SPP accelerated action were:

- Protect North Walnut Creek by reducing the mass loading of nitrate to surface water and ensure that surface water standards are met in the Creek.

- Design and install a passive system to intercept and treat the contaminated groundwater of the SPP to remove nitrate.

- Design and construct the reactive barrier system in a manner which minimizes the generation of low-level mixed waste and/or hazardous waste and protects the habitat of Preble's Meadow Jumping Mouse, which was added to the Threatened Species List on May 18, 1998.

- Design the reactive barrier system to allow easy access for operations and maintenance and reactive media replacement or removal.

- Evaluate effectiveness of reactive barrier system in removing nitrate.

The system is located north of the SEPs and is designed to collect and treat the nitrate and uranium contaminated groundwater before it reaches North Walnut Creek, the nearest

downgradient surface water body. System installation began in June of 1999 and was completed on September 22, 1999. Construction was mainly limited to the previously disturbed area adjacent to the North Access Road to minimize impacts to Preble's mouse habitat. Re-vegetation was completed in October of 1999. The 1,100 feet long collection system was installed within a ditch excavated to 20 to 30 feet below land surface and approximately 10 feet into the underlying claystone.

The intercepted water is routed from the drain pipe within the sand envelop to the adjacent 46 feet long by 21 feet wide concrete vessel containing the two treatment cells. The final location of the treatment vessel was dictated by the nearby Preble's meadow jumping mouse habitat. The proximity of the habitat resulted in placing the treatment system directly adjacent to and on grade with the deepest portion of the collection system. This was a modification to the original planned location for the treatment cell. The resultant grade requires the accumulation of approximately 11 feet of water within the collection system before water will flow into the treatment vessel.

The exterior treatment vessel is divided into two treatment cells by an 18-inch thick, twelve feet high internal wall. The first cell is 31 feet long by 17 feet wide and is filled with a mixture of sawdust and leaf mold and 10% zero–valent iron filings by weight to induce de-nitrification and uranium removal by chemical reduction. The organic material provides the growth medium and food source for bacteria to mineralize the nitrate by utilizing it as a metabolic nutrient. The second cell is 10.5 feet long by 17 feet wide and contains only iron filings to act as a final uranium polisher to remove uranium from the water. The treatment vessel is plumbed to allow the cells to operate in series or parallel.

Based on calculations that were provided by the CDPHE during development of the IM/IRA, the current temporary stream standard of 100 mg/l nitrate would be achieved if treatment system effluent concentrations did not exceed 500 mg/l (DOE 1996b). For the contaminated ground water passing through the treatment system, the treatment system is actually operating at much greater removal efficiency than anticipated by the previous laboratory bench tests.

4.10 Solar Evaporation Ponds Sludge Source Removal

Background

The five SEPs are located in the northeastern portion of the Industrial Area, and were used to process the site's liquid waste streams from 1953 to 1986. Three previous ponds were located at or in the immediate vicinity of the current 207C Pond. Two of these ponds were constructed in 1953. The ponds were utilized, emptied and removed from operation in 1956 for the installation of clay liners following completion of the current 207A Pond. The ponds were returned to operation later that year. The third original pond was constructed in 1959 to contain potential overflow from 207A. The three original ponds were removed from service in 1960 when the B Series Ponds commenced operation. The southernmost of the original ponds was re-graded for the construction of B-779 in 1962. The other two original ponds were re-graded and are now the site of the current 207C Pond constructed in 1970. The current five ponds were emptied and relined several times since their construction. Resultant wastes were shipped offsite for disposal

during the relining operations. The most recent sludge and water removal action, accomplished from 1993 to 1995, is the subject of this review.

The SEPs stored and evaporated process wastewater containing nitrates, neutralized acidic process waste, and low level radioactive isotopes. The five currently existing SEPs 207A, 207B-North, 207B-Center, 207B-South, and 207C were granted interim status under RCRA/CHWA by CDPHE pursuant to an August 1986 Compliance Agreement (Agreement Number RCRA-VIII-86-08). RCRA Corrective Action or Closure of the Interim Status Unit (the five empty ponds) will be documented under a separate decision document. A groundwater collection and treatment system, installed under a previous accelerated action IM/IRA to address associated contaminated groundwater, was completed in 1999.

Project Description

The purpose of the source removal efforts at the SEPs was to remove the potential continuing source of nitrate and uranium contamination that exists in soils and groundwater beneath and adjacent to the SEPs. As discussed above, several water and sludge removal and relining efforts were undertaken in the 1950s to 1970s to enhance the operation and/or life span of the previous and current ponds.

The most recent removal of sludge and water from all five ponds was conducted as a routine operation within a RCRA Interim Status Unit Undergoing Closure. The only regulatory documentation required was the modification made to the RCRA Part B Permit. The removal operation was conducted by consolidating the material in a clockwise fashion from 207A to 207B-South. The excess water within a pond was decanted to B-374 for treatment by evaporation. Sufficient water was retained within the pond to suspend the sludge and allow transfer of the homogenized mixture into the adjacent pond. The entire sludge and remaining water inventory was finally consolidated into pond 207B-South. The material was then removed from 207B-South and transported via vacuum trucks to RCRA-permitted 10,000-gallon plastic, double walled tanks installed on the 750 Pad. Excess water was then removed from the 207 A&B pond material by allowing the sludge to settle and pumping off the remaining water. More mixture would then be added from 207B-South and allowed to settle and the decanting operation would continue until the tank was filled to the design level.

The 207C contents are significantly different from that of the other four ponds and warranted separate handling requirements. The 207C material consists of water, sludge, and brine layers of varying thickness and volume. A grinder mounted on a front loader was used to grind the brine and sludge to facilitate homogenization and removal of the material from the pond. This material was also pumped into vacuum trucks and transported to the adjacent 750 Pad for storage within the 10,000-gallon tanks. The water decanting operation was not conducted on the 207C material because of its chemistry and consistency.

4.11 OU 7 Seep Accelerated Action

Background

OU 7 is located in the buffer zone north and west of the Industrial Area at the western reach of No Name Gulch and includes the following areas:

- Present Landfill (IHSS 114)
- Inactive Hazardous Waste Storage Area (IHSS 203)
- East Landfill Pond
- Spray Evaporation Areas adjacent to the East Landfill Pond (IHSSs 167.2 and 167.3)

The OU 7 seep accelerated action is located near the base of the east face of the Present Landfill.

The landfill was operated for the purpose of disposal of solid wastes from 1968 until 1998. The landfill ceased accepting waste in 1998 and was temporarily covered with soil and native grass. The final cover is currently under evaluation and design and will be presented in an IM/IRA in October of 2002. The Present Landfill encompasses an area of approximately 27 acres. The waste materials were disposed as a valley fill operation within the previously existing and relatively narrow head of No Name Gulch. Further disposal toward the east filled the upper reaches of the drainage to the current extent of the Present Landfill.

Tritium was detected in water seeping from the landfill in 1973. Monitoring of waste prior to burial was then initiated to prevent further disposal of radioactive material. In addition, interim response measures, including slurry walls and groundwater diversion system, a leachate collection system, and surface water diversion ditches were developed to control the generation and migration of landfill leachate. Intensive controls were established in 1986 to prevent the disposal of hazardous constituents in the landfill.

A Phase I RCRA RFI/RI was conducted in 1992 and 1993 to characterize the site features and make preliminary determinations of the sources of and nature and extent of contamination. The Phase II RFI/RI was conducted in 1994 and 1995 to further define the nature and extent of contamination and to support the initial decision document. (DOE 1995b).

Groundwater flow in the area is controlled to some extent by the bedrock surface features and the leachate collection and groundwater diversion systems. The leachate collection and groundwater diversion systems are only partially effective. The current options analysis and preliminary design associated with the OU-7 IM/IRA will evaluate means of effectively preventing the migration of precipitation and groundwater into the wastes and the generation of leachate.

The primary contaminants associated with the OU 7 seep that are detected above background concentrations are VOCs, semi-volatile organic compounds, total and dissolved metals, and radionuclides. The contaminants that have periodically been detected above RFCA Action Levels during performance monitoring are vinyl chloride and benzene (KH 2000a).

Project Description

Two separate OU 7 Seep accelerated action projects were conducted to construct and operate seep collection and treatment systems. The initial action was undertaken in 1995 in accordance with an approved PAM (DOE 1995b). The objective of this action was to eliminate the discharge of the landfill leachate contaminated seep water to the downstream pond. The action included the construction of a passive groundwater/seep collection system with associated plumbing and a treatment vault containing Granular Activated Carbon (GAC) to remove the organic contaminants before discharging the water to the landfill pond. The system operated from May of 1996 to October of 1998.

The effectiveness of the treatment system was evaluated in the fall of 1998. The evaluation indicated that the primary contaminants detected above the established performance standards are benzene and vinyl chloride. GAC has a very limited capacity to attenuate vinyl chloride and the system would require costly monthly carbon replacement to maintain removal effectiveness. As a result of this evaluation, the treatment system was modified in October 1998 to treat the seep water by passive aeration, and sampling and analyses for semi-volatile organic compounds, metals and radionuclides was discontinued. The objective of the modified treatment system is to reduce contaminants to meet RFCA surface water standards.

The following table lists the COCs for future performance monitoring and their respective standards.

Table 6

OU 7 Seep Treatment System Water Analytes and Performance Standards

VOC Analytes	RFCA Surface Water Standard (µg/L)
Cis 1,2-Dichloroethene	70
Benzene	1
Chloromethane	5.7
Ethylbenzene	680
Methylene Chloride	5
Tetrachloroethene	1
Toluene	1,000
Trichloroethene	2.7
Vinyl Chloride	2
Xylene (Total)	10,000

RFCA values are based on RFCA. Attachment 5, Table 1, Surface Water Action Levels & Standards, March 2000.

The seep water is collected in a settling basin, flows via pipe through the previously existing but empty treatment vault to a set of stepped flagstones, and finally flows over and through a gravel aeration bed before discharging to the landfill pond. The tumbling action enhances the aeration of the water and effectively removes the contaminants. Flow is measured at the discharge point. Effluent water quality samples are collected six feet downstream of the final flagstone aeration step. Water released from the aeration system is retained in the landfill pond and is periodically pumped into Pond A-3 lower in Walnut Creek. All water flowing through the North Walnut Creek drainage passes through two RFCA POCs before leaving the RFETS property.

4.12 Underground Storage Tanks Source Removal Project

Background

Six IAG underground storage tanks (USTs) are located within what was formerly known as OU 9, Original Process Waste Lines (OPWL). They were part of the OPWL network of tanks and underground pipes to transport and temporarily store process waste. Table 7 below lists the locations and history of these tanks.

Table 7 – Tank Location and History

Tank Number	Location and History	Description
Tank-2	South of B441, Formerly received waste from B123 and B441	Underlying tank and overhead chambers, a limestone bed, and wet well
Tank-3	South of B441, Formerly received waste from B123 and B441	Underlying tank and overhead chambers, a limestone bed, and wet well
Tank-10	West of B730, Received on-site laundry waste from B778	Two 4,500-gallon concrete underground tanks
Tank-14	East of B774, Received B774 treated transuranic aqueous mixed waste	One 30,000-gallon concrete underground holding tank
Tank-16	East of B774, Received B774 treated transuranic aqueous mixed waste	Two 14,000-gallon underground concrete holding tanks
Tank-40	West of B889; Received wastes from B889-acids, radionuclides, solvents	Two underground concrete 1000-gallon tanks

Project Description

The IAG Underground Storage Tank Source Removal Project at Rocky Flats consisted of accelerated remedial actions to remove residual liquids and sludge from six underground storage tanks. The scope of the accelerated activities was derived from the Accelerated Action Plan for the Interagency Agreement Underground Storage Tanks Containing RCRA-Regulated Materials (RMRS 1995c). The removal action objectives included stabilizing possible residual contamination in underground storage tanks to prevent further migration of contaminants, and minimizing risk to human health and the environment by fixing any remaining contamination.

An accelerated action plan outlined the actions to be performed on the six tanks. The action was conducted in compliance with the PAM for the Contaminant Stabilization of Underground Storage Tanks (RMRS 1996c). This included removal of existing tank contents; rinsing of the tanks to remove any gross contamination; and sampling and laboratory analysis of the rinsate to document the extent of any contamination remaining in the tanks. In addition it included managing and treating liquid contents and rinsate onsite, and managing sludge onsite pending appropriate offsite disposition, and filling the tanks with an inert closed-cell foam (polyurethane) to stabilize potential residual contamination, prevent groundwater and surface water infiltration, and preserve tank integrity. The source removal actions were completed by September 30, 1996.

All materials and wastes generated by the above activities were characterized and dispositioned. The liquids removed from the tanks were treated at onsite facilities such as B891, 774, and 374. Sludge removed from Tank-2, Tank-3 and Tank-40 were containerized in 55-gallon drums for storage as radioactive mixed waste in RCRA Unit No. 1 until appropriate offsite disposal is authorized. Approximately 200 gallons of sludge was removed from Tank-40 tanks prior to rinsing and foaming. The sludge that was generated from Tank-2 and Tank-3 at B441 are stored at 750 hazardous waste Unit 1. Sludge removed from Tank-10, Tank-14, and Tank-16 were transferred to B774 for interim storage as radioactive mixed waste. Auxiliary equipment, debris, and contaminated personal protective equipment was containerized and stored as low-level waste in B664.

4.13 No Further Action/No Further Remedial Action Sites

Through process knowledge and characterization, the Site has identified and proposed IHSSs and Potential Areas of Concern which may qualify as No Further Action/No Further Remedial Action (NFA/(NFRA) Sites. These sites are proposed as NFA/NFRA sites in the Historic Release Report and subsequent annual and quarterly updates of the Historical Release Report (DOE 1992 and DOE 1992a). Sites are approved as NFA/NFRA sites by CDPHE and EPA based on process knowledge, analytical data, conservative risk-based screens, and/or formally conducted interviews. The approval process is described in RFCA Attachment 6. This approval provides a determination that accelerated action to render the site protective is not currently warranted; however, such decisions are subject to re-evaluation at the time of the RI/FS and Comprehensive Risk Assessment. All NFA/NFRA decisions will be documented in the final CAD/ROD. Appendix C of this report contains the status of proposed NFA/NFRA sites.

5.0 PROGRESS SINCE LAST FIVE-YEAR REVIEW

This is the first five-year review for the site.

6.0 FIVE-YEAR REVIEW PROCESS

6.1 General

The RFETS Five-Year Review was conducted by DOE in accordance with CERCLA, Section 121(c), EPA Guidance (EPA 2001a) and with paragraph 254 of RFCA. The following team members actively participated in the review:

Sean Bell, DOE, Office of Chief Council
Bob Birk, DOE, Performance Assessment and Projects Support
Norma Castaneda, DOE, Environmental Restoration
Jon Dion, DOE, Regulatory Compliance
Russell McCallister, DOE, Environmental Restoration
Lisa O'Mary, DOE, Environmental Restoration
John Rampe, DOE, Communications and Stewardship
Mark Sattelberg, U. S. Fish and Wildlife Service
John Stover, DOE, Infrastructure/Stewardship
Scott Surovchak, DOE, Environmental Restoration
Steve Tarlton, Colorado Department of Public Health and the Environment
Reg Tyler, DOE, Environmental Restoration

This Five-Year Review primarily consisted of a review of relevant documents (see Appendix A), a review of relevant data including groundwater, surface water, biota, and air monitoring data (see section 7.2), and an inspection of sites analyzed in this report. (See Appendix D.) As appropriate, specific documents and data were summarized to support the conclusions and recommendations documented in this report.

6.2 Site Inspections and Site Interviews

Inspections were conducted at the RFETS on February 13 and March 5, 2002, by staff from DOE, Colorado Department of Public Health and Environment, and the U. S. Fish and Wildlife Service. Inspection reports are included as Appendix D of this report. Sites inspected included Operable Unit 1 (881 Hillside), Trenches 1, 3 and 4, Mound Site, Operable Unit 4 (Solar Ponds), Ryan's Pit, and the reactive barriers for the East Trenches Plume and Solar Pond Plume. The purpose of these inspections was to assess the physical conditions of the sites evaluated during this Five-Year Review.

There were no visible significant problems identified with respect to the remedies/accelerated actions. One minor issue was inconsistent use of rope/radiation postings to delineate the boundaries of removal actions. T-3 and T-4 were roped off but the Mound Site and T-1 were not. Posting requirements were researched and it was discovered that T-4 was posted correctly because it is considered an underground radioactive material area and is located outside the Site's Industrial Area underground radioactive material area posting. The Mound Site and T-1 were not required to be posted because they are within the boundaries of the Site's Industrial Area posting and are not Soil Contaminated Areas by definition. T-3 is currently conservatively posted and the status is being researched. The posting will be changed if necessary.

One recommendation resulting from the inspection is to further research long-term maintenance requirements for the reactive barriers. The Site needs to better understand these requirements in order to plan for the long-term stewardship mission of the RFETS.

Formal interviews were not conducted as part of this review due to the ongoing nature of cleanup activities. However, informal interviews were conducted as part of the site inspection process and during research into remedies and accelerated actions. For example, during the inspection of the groundwater plume reactive barriers Kaiser-Hill personal were available to answer questions concerning the operation and maintenance of these groundwater treatment system.

6.3 Community Involvement

Community involvement was encouraged throughout the Five-Year Review process. Initial public notification of this review was provided by notice in the local newspapers during January 2002. Throughout the review process interested stakeholder groups were briefed. This included briefings at the monthly Environmental Restoration/Decontamination & Decommissioning Status meetings on January 15, February 19, and April 16, 2002, a briefing to the RFETS Citizens Advisory Board on February 7, 2002, and a briefing to the Stewardship Working Group on February 28, 2002. The review report was made available for public comment during April,

May and June 2002. Comments and responses are included in Appendix B of this report. A copy of the final report will be placed in the Administrative Record file, provided to interested members of the public and will be available in the RFETS reading rooms.

7.0 Five-Year Review Findings

7.1 Review of Regulations, Standards, ARARs

The RFCA Parties, DOE, EPA and CDPHE have committed to review the Agreement to determine if any revisions are necessary. RFCA paragraph 5 states:

> *The Parties shall conduct an annual review of all applicable new and revised statutes and regulations and written policy and guidance to determine if an amendment pursuant to Part 19 (Amendment of Agreement) is necessary.*

In addition to the annual review prescribed in RFCA paragraph 5, the agencies committed to conducting an internal annual review of the radionuclide soil action levels (RSALs). For comprehensive treatment of the history of changes governing cleanup of Rocky Flats since the signing of the RFCA document, the annual reviews performed by the parties are incorporated by reference. They are:

- 2000 Rocky Flats Cleanup Agreement Annual Review, January 2001. (RFCA 2001)
- 1999 Rocky Flats Cleanup Agreement Annual Review, September, 1999. (RFCA 1999)
- 1998 Rocky Flats Cleanup Agreement Annual Review Radionuclide Soil Action Levels (RSAL) Review Summary, September, 1998. (RFCA 1998)
- 1997 Regulatory/Radionuclide Soil Action Levels Rocky Flats Cleanup Agreement Annual Review, August, 1997. (RFCA 1997)

These reviews are summarized below.

2000 Review Summary

The 2001 Regulatory/Radionuclide Soil Action Level Annual Review covers the period from July 1, 2000 through June 30, 2001. The following environmental laws and associated regulations, written policy, and guidance were reviewed:

Comprehensive Environmental Response, Compensation, and Liability Act;
Resource Conservation and Recovery Act/Colorado Hazardous Waste Act;
Toxic Substances Control Act;
Clean Water Act;
Clean Air Act;
National Environmental Policy Act;
Endangered Species Act;
Radiation Related Document Review; and
Defense Authorization Acts and Appropriation Acts.

In addition to the above environmental laws and the radionuclide soil action levels, the Action Levels and Standards Framework for Surface Water, Groundwater, and Soils (ALF); the Preliminary Programmatic Remediation Goals (PPRGs); and the Implementation Guidance Document (IGD) were reviewed. Based on the review of the environmental statutes and associated regulations, written policy, and guidance, no amendment to RFCA was required as of January 2001 for the previous year. However, changes have been incorporated into RFCA Appendix 3, IGD, Appendix K, Master List of Potential ARARs, where necessary.

The Colorado Water Quality Control Commission decided to delete the narrative temporary modifications for americium and plutonium in Segment 5 of Walnut Creek that were effective June 30,1999. The Water Quality Control Commission classified Big Dry Creek Segment 4a as Recreational Class 1a, affecting fecal coliform and E. coli standards.

The RSAL review by the RFCA parties is still on going. Upon completion of the review, modifications to the RSALs will be proposed and the public will have an opportunity to review and comment on proposed changes to ALF as required in RFCA paragraph 117. After consideration of public comment, the RSALs will be modified. This is expected to occur in mid-2002.

Actinide migration is still being studied and monitored.

1999 Review Summary

No amendment to RFCA was required at the time of review. From July 1, 1998 through July 1, 1999, the RFCA parties reviewed the following environmental laws and associated regulations, written policy and guidance:

Comprehensive Environmental Response, Compensation, and Liability Act;
Resource Conservation and Recovery Act/Colorado Hazardous Waste Act;
Toxic Substances Control Act;
Clean Water Act;
Clean Air Act;
National Environmental Policy Act;
Endangered Species Act;
Radiation Related Document Review.

In addition to the above environmental laws and the radionuclide soil action levels, the Action Levels and standards Framework for Surface Water, Groundwater, and Soils; the PPRGs; and the IGD were reviewed. The Defense Authorization Acts and Appropriation Acts for FY 99 were also reviewed.

The Colorado Water Quality Control Commission adopted narrative temporary modifications for americium and plutonium applicable in Segment 5 of Walnut Creek. The narrative standard is that concentration that is consistent with attaining the numerical water quality standards in segment 4(b) of Big Dry Creek. These temporary modifications were effective June 30, 1999 to

December 31, 2000. The temporary modifications were incorporated into RFCA Attachment 5, ALF.

Changes identified by the RFCA Parties in 1999 as impacting ALF were the Colorado Water Quality Control Commission's adoption of the temporary modifications for americium and plutonium applicable in stream segment 5 of Walnut Creek and updated PPRGs. The updated PPRGs impacting ALF are Groundwater Action Levels for Di-n-octylphthalate; 2-Methylnaphthalene; Naphthalene and Surface Soil Action Levels for Di-n-octylphthalate; 2-Methylnaphthalene;Naphthalene; and 1,1,1-Trichloroethane for both industrial use and open space use.

1998 Review Summary

The RSAL Working Group identified and reviewed eleven new or revised statutes, regulations, written policy and/or guidance that may have impacted RSALs. This year's review focused on four primary areas: (1 regulatory basis for setting RSALs; (2 computer models; (3 exposure parameters; and (4 input parameters at other DOE Sites. The RSALs were based on the computer model "RESRAD," Version 5.61.

From July 1, 1997 through July 1, 1998, the RFCA parties reviewed the following environmental laws and associated regulations, written policy and guidance:

Comprehensive Environmental Response, Compensation, and Liability Act;
Resource Conservation and Recovery Act/Colorado Hazardous Waste Act;
Toxic Substances Control Act;
Clean Water Act;
Clean Air Act;
National Environmental Policy Act;
Endangered Species Act;
Radiation Control Regulations.

In addition to the above environmental laws and the radionuclide soil action levels, the Action Levels and standards Framework for Surface Water, Groundwater, and Soils; the PPRGs; and the IGD were reviewed. There were one amendment and two final rules impacting the RCRA/ CHWA regulations during the year:

1. Used oil management requirements
2. Organic air emissions monitoring and reporting requirements (subpart cc); and
3. Land Disposal Restrictions (LDR) requirements Phase IV, parts 1 and 2.

RFETS characterization procedures were modified to incorporate LDR changes. The LDR standards for hazardous waste soils have been modified by the final Phase IV LDR rule. The modification requires the treatment of soils to either a 90% reduction of, or ten times the Universal Treatment Standards.

EPA issued a final rule on the Disposal of Polychlorinated Biphenyls (PCBs) on June 29, 1998, effective on August 28, 1998 (63 FR 35384).

The U.S. Fish and Wildlife Service issued a final determination to list the Preble's meadow jumping mouse as a threatened species under the Endangered Species Act on May 13, 1998 (63 FR 26517). DOE must consult with the U.S. Fish and Wildlife Service on any actions that may affect the mouse.

With regard to Radiation Related Document Review, changes in the environmental regulations, written policies, and guidance have been incorporated into the RFETS Master List of Potential Applicable or Relevant and Appropriate Requirements (IGD Appendix J). Appendix P and Appendix L of the IGD were also updated.

Numerous RSALs related documents were being evaluated, with the understanding that upon completing the evaluation, the RSALs may need recalculating.

1997 Review Summary

Material reviewed included:

Comprehensive Environmental Response, Compensation, and Liability Act;
Resource Conservation and Recovery Act/Colorado Hazardous Waste Act;
Toxic Substances Control Act;
Clean Water Act;
Clean Air Act;
National Environmental Policy Act;
Endangered Species Act;
Ecology (e.g., Endangered Species Act); and
Radiation Control Regulations.

In addition to the above environmental laws and the radionuclide soil action levels, the Action Levels and Standards Framework for Surface Water, Groundwater, and Soils and the PPRG were reviewed. Based on the review, no new or revised statutes, regulations, written policy or guidance were identified as final from July 19, 1996 to July 1, 1997 that impacted RFCA or required an amendment. On July 21, 1997, the Nuclear Regulatory Commission issued a final rule on radiological Criteria for License Termination.

The Preble's meadow jumping mouse was proposed for listing on the Threatened and Endangered Species List by the U.S. Fish and Wildlife Service.

The ALF was reviewed to determine if any changes to standards or action levels were necessary. Changes to the original ALF were made on October 18, 1996 to reflect the interim radionuclide soil action levels.

Changes to toxicity factors possibly impacting PPRG calculations related to groundwater were included as attachment 2.

The RESRAD computer model was used in the original derivation of RSALs, and RESRAD was updated, but still deemed appropriate for deriving RSALs.

On July 21, 1997, a final rule from the Nuclear Regulatory Commission, 10 CFR Part 20, Radiological Criteria for License Termination, was published in the Federal Register. The rule may be appropriate for use in guiding cleanup at Rocky Flats. The issuance of the rule was assumed by the RFCA parties to be related to soil action levels and decommissioning levels and was being evaluated.

7.2 Data Review

7.2.1 Geology, Hydrogeology and Groundwater Data Review

The Site is situated approximately two miles east of the Front Range of the Rocky Mountains on the western margin of the Colorado Piedmont section of the Great Plains Physiographic Province. The elevation at the Site is approximately 6,000 feet above mean sea level. The Industrial Area of the Site is located on an alluvial-covered pediment. The upper surface of the alluvium slopes easterly 1 to 2 degrees. Most of the surrounding area in the Buffer Zone is more prominently dissected with intermittent streams. These small, eastward flowing streams include Rock Creek, Walnut Creek, Woman Creek, and several surface water diversion ditches.

No active faults have been identified at the Site. Several high angle bedrock faults have been inferred to exist in the Industrial Area based on various stratigraphic and borehole correlation criteria. These faults appear to have only a limited hydrologic significance with regard to vertical groundwater movement and contaminant transport.

Characterization of the hydrogeologic setting is based on the currently accepted conceptual geologic and hydrogeologic models described in the Sitewide Geoscience Characterization Study (EG&G 1995a). These conceptual geologic and hydrogeologic models are used to predict the direction and rate of groundwater flow, identify potential pathways for contaminant migration, and determine the extent of contaminant plumes given varying physical, chemical, and biological factors.

Groundwater recharge occurs from the infiltration of incident precipitation and as base flow near the upgradient area of the Site drainage basin that extends west to Coal Creek. Groundwater recharge also occurs from stream, ditch, and pond seepage.

The depth to water generally becomes shallower from west to east as the alluvial material thins and the underlying claystones are closer to the ground surface. At the head of stream drainages and along valley sides, seeps are common. In summary, the unconsolidated surficial materials are thicker in the western, higher elevations at the Site. Accordingly, the saturated thickness of these materials also thins eastward.

Shallow groundwater flow is primarily lateral because of the low permeability of the underlying claystone bedrock. Groundwater in the ridge tops generally flows toward the east-northeast. In areas where the ridge tops are bisected by east-northeast trending stream drainages, groundwater flows to the north or south toward the bottom of the valleys. In the valley bottoms, groundwater

flows to the east, generally following the course of the stream. The upper hydrostratigraphic unit (UHSU) at the Site has a relatively low to moderate hydraulic conductivity that typically yields small amounts of water to groundwater monitoring wells.

Groundwater Contaminants

Compared to all other contaminants, groundwater VOC plumes at RFETS have the greatest potential to impact surface water, based on spatial distribution, mobility, and concentration considerations. Six VOC groundwater contaminant plumes have been identified where contaminant concentrations are above Tier I action levels. These groundwater contaminant plumes include the IHSS 119.1 Plume, Mound Plume, 903 Pad/Ryan's Pit Plume, Carbon Tetrachloride Plume, East Trenches Plume, and Industrial Area Plume. In addition, there are two plumes with contaminant concentrations above Tier II action levels. These two VOC plumes are associated with the Present Landfill and the Property Utilization and Disposal Yard.

In addition to the VOC plumes, there is a nitrate and uranium plume that emanates from the Solar Evaporation Ponds area. There are other sources with constituents that are above Tier II action levels. These were or are being evaluated on a case by case basis. See Section 4.0 and 8.3 for descriptions of the specific actions taken to control these point source plumes.

The Integrated Monitoring Plan (IMP) is a summary document that outlines the goals for groundwater monitoring (and other environmental media), and describes the various components of the groundwater monitoring program (K-H 2000b). Factors influencing groundwater monitoring requirements include the RFCA ALF for groundwater, the Site history and areas of contamination, the physical and hydrogeologic setting of the Site, the effect of contaminated areas on groundwater, and the nature of the groundwater contaminant plumes.

Groundwater reporting has been integrated under the IMP. Four quarterly reports are produced annually that document concentration values above RFCA action levels. A RFCA Annual Groundwater Report is also required to summarize all actions taken for groundwater compliance within each calendar year.

7.2.2 Surface Water Data Review

Several water management programs, which began in the early 1990s to implement protective measures for downstream communities and to maintain compliance with applicable laws and regulations, were completed during this five-year period. Numerous studies and water monitoring programs have been established to demonstrate compliance, measure the effectiveness, and to identify and develop possible improvements of the Site's remediation activities and protective measures. Water quality data from monitoring indicate that these programs are successful. (See Table 8a and 8b below.)

Surface Water Monitoring Programs

Site staff, regulators and stakeholders monitor the water quality of surface water leaving the site under the different programs that are listed below. DOE has also implemented project specific surface water performance monitoring. The objective of project specific performance monitoring is to identify the impacts (if any) caused by Site actions on surface water quality.

Performance monitoring for most D&D and remediation projects in the Industrial Area are covered by existing RFCA monitoring objectives downstream (i.e. new source detection and points of evaluation). However, if a project poses a special concern for contaminant releases or contaminants of concern are not adequately monitored downstream, project specific performance monitoring will be implemented. The Site's water program has developed a template to screen candidate projects to determine if specific project monitoring may be necessary.

RFCA Water Quality Monitoring

Samples from several RFCA action level measuring points (also referred to as Points of Evaluation (POEs)) and Points of Compliance (POCs) at the Site are collected to assess compliance with the RFCA water quality action levels and standards for radionuclides. The RFCA action level and standard for both plutonium and americium is 0.15 pCi/l. These standards correspond to a one in one million excess cancer risk to a person drinking two liters of water per day for thirty years. Compliance with these standards is determined by calculating rolling thirty-day, flow-weighted averages for plutonium and americium. Site personnel evaluate 30-day moving average for radionuclides at the POEs and POCs.

ALF establishes POCs for segment 4a/4b at the outfalls of the terminal ponds (A4, B5, C2), and at two locations where Walnut Creek (GS03) and Woman Creek (GS01) cross Indiana Street. In accordance with the IMP, the analytes of interest for the POCs located in segment 4a/4b (Walnut and Woman Creek drainages below the terminal ponds) are plutonium, americium, uranium, pH, conductivity, turbidity, and total suspended solid (tritium is also an analyte of interest at Indiana Street). Tritium was never routinely used at the RFETS, and it has not been detected at any POC. Uranium concentrations have never exceeded the RFCA water quality standard at the outfalls of the terminal ponds, even though uranium occurs naturally in relatively high concentrations in the area.

National Pollution Discharge Elimination System Monitoring

The Site's National Pollutant Discharge Elimination System renewal permit (Permit No. CO-0001333) became effective on October 27, 2000. Permit monitoring occurs at the Building 995 effluent (STP1), and the Building 374 product water effluent (Outfall 14). Monitoring results at STP1 and Outfall 14 are summarized in the Site's monthly Discharge Monitoring Reports, which are submitted to EPA and CDPHE each month according the Permit.

The new permit contains the applicable storm water provisions and identifies four storm water outfalls. Monitoring of the effluent is also done under RFCA to measure radionuclides. A POE (995 POE) was established at the wastewater treatment plant outfall. Plutonium, americium, uranium, and tritium are monitored at 995 POE, which is co-located with STP1. The analytical data from the 995 POE sampling is reported in the Quarterly Environmental Report.

CDPHE Surface Water Monitoring

Sampling and analysis by CDPHE is performed according to the Rocky Flats IMP. Occasionally, CDPHE performs additional sampling as part of a special study or for some unusual circumstance. The results of both types of monitoring can be found in CDPHE's Quarterly Environmental Surveillance Reports. A summary of the Report is presented at the

Quarterly Data Exchange meetings and copies are provided at the meetings, in the Rocky Flats Reading Room, and on the internet.

Stakeholder Monitoring

The City of Broomfield collects water quality data for radionuclides, including plutonium and americium, on a quarterly basis from Great Western Reservoir. For the period 1997-2001 the highest value for plutonium was 0.012 pCi/l, and the highest value for americium was 0.009 pCi/l. In both cases, however, the numeric value of the counting error was higher than the reported value. This was the case for many of the sample results from Great Western Reservoir. Samples are collected from each pond discharge in the Walnut Creek drainage. Data is from the sampling events is presented at the Quarterly Data Exchange meetings and is published by the City of Broomfield.

Water discharged from Pond C2 is collected in the Woman Creek Reservoir. Water in the Reservoir is sampled and analyzed by the City of Westminster before it is pumped to Walnut Creek below Great Western Reservoir. Water quality has not been a problem and has never prevented a discharge to Walnut Creek from Woman Creek Reservoir.

Ponds

Currently there are 12 detention ponds located in the Walnut Creek and Woman Creek drainages, which collect surface water runoff and waste water discharges. The ponds serve, to varying degrees, three main purposes 1) storm water detention and settling of sediments, 2) water storage for sampling prior to release, and 3) emergency spill control. Site personnel manage the ponds in the Woman Creek and Walnut Creek drainages. Water management consists of monitoring pond levels, measuring water quality, and releasing water through valves or other diversions. Currently, the terminal ponds (A-4, B-5, and C-2) are operated in a "batch and release" mode. Water samples are collected from the ponds while they are filling, and analytical results for the samples are reviewed prior to release of the water.

Conclusions

Data from the Walnut and Woman Creek POCs collected from January 1, 1997 through 2001 have shown consistent compliance with the RFCA water quality standards for both plutonium and americium (Tables 8a and 8b). The average concentrations of plutonium and americium from the POC at Walnut Creek and Indiana Street from 1997-2001 were 0.012 and 0.009 pCi/l, respectively. Average concentrations of plutonium and americium from the POC at Woman Creek and Indiana Street from 1997-2001 were 0.005 and 0.004 pCi/l, respectively. The highest individual sample result for plutonium at either POC was 0.220 pCi/l collected at the Walnut Creek and Indiana POC on April 9, 1997. This sample result did not cause RFETS to exceed the thirty-day, flow-weighted average for plutonium. As a point of reference for the tritium concentrations reported in Tables 8a and 8b, background concentrations of dissolved tritium in stream water have been observed to vary over a range from non-detectable to 686 pCi/l with a mean of 112 pCi/l, based on 73 samples (Background Geological Report, 1993). Tritium concentrations observed at the Site lie within this background range.

DOE concludes, on the basis of water quality results from Walnut Creek, Woman Creek and Great Western Reservoir that significant amounts of plutonium and americium have not left the Site through the water pathway since the active remediation of the Site began. DOE does not believe that environmental conditions offsite have changed significantly as a result.

The following risk estimate supports this conclusion. Based on the plutonium and americium concentrations reported in surface water, the additional individual health risk would be approximately $1.4E^{-7}$ from exposure to plutonium and americium combined; that is, 1.4 cancers in 10 million people consuming 2 liters per day of that water for 30 years. Such a small risk is not measurable in a human population. Further, this risk has been calculated based on a surface water standard that was set using now out-of-date cancer slope factors. Using current slope factors, the risk is actually less than half of that quoted above.

As part of the ongoing efforts to close the Site in a safe and environmentally responsible manner, the Site will:

1. Continue progress on the actinide migration evaluation as a longer-term technical study to provide more specific understanding and insight about the cause(s) and possible effective mitigation measures to prevent reportable radionuclide water-quality measurements;
2. Continue an extensive program of routine monitoring, analysis, and reporting to improve our understanding of potential diffuse source impacts to surface water;
3. Continue use of the existing terminal ponds to protect POCs from all closure activities having the potential to impact surface water at the POCs through active remediation;
4. Continue to develop and refine the soil characterization strategy within the Industrial Area Strategy, as needed to protect surface water;
5. Continue to provide progress reporting through Quarterly RFCA Reports, Quarterly State Exchange Meetings, actinide migration evaluation reports, and informal status/flash briefs.

TABLE 8a - Water Monitoring Data from 1/01/97 to 12/04/01 at GS03

Summary Statistics			
	Pu-239, 240	Am-241	Tritium
Minimum	0.000	0.000	0
Maximum	0.220	0.059	490
Mean	0.012	0.009	103
Median	0.007	0.006	62
85 Percentile	0.021	0.019	240
# of analysis	159	160	154

Attainment of chronic chemical standards, in both streams and rivers, and in lakes and reservoirs systems, is based upon the 85th percentile of the ranked data.

TABLE 8b - Water Monitoring Data from 1/01/97 to 12/04/01 at GS01

Summary Statistics			
	Pu-239,240	Am-241	Tritium
Minimum	0.000	0.000	0
Maximum	0.024	0.039	480
Mean	0.005	0.004	98
Median	0.003	0.002	69
85 Percentile	0.010	0.008	225
# of analysis	101	100	98

Attainment of chronic chemical standards, in both streams and rivers, and in lakes and reservoirs systems, is based upon the 85th percentile of the ranked data.

7.2.3 BIOTA

Since the RFETS natural resource compliance and protection program was established in 1992, Site ecologists have conducted routine surveys to monitor the high-visibility and sensitive wildlife groups and habitat types. These wildlife surveys include population estimates for; migratory birds, big game animals, lagomorphs and large rodents, carnivores, waterfowl, raptors, fish, herptiles, and species that are afforded special protection by federal and state statutes. Vegetative community surveys include; xeric tallgrass prairie, tall upland shrubland, Great Plains riparian woodland complex, high quality wetlands, mesic mixed grassland, and aquatic communities. Ecological monitoring at the Site has historically focused on characterization of the ecological components within the Buffer Zone and compliance with a variety of regulatory drivers. Continuation of this program as a long-term monitoring program has provided a continuous record of these selected species and habitats that can be compared among years. These long-term surveys are the basis for the Ecological Monitoring portion of the Rocky Flats Environmental Technology Site IMP. Each year the IMP is reviewed and special sampling and monitoring may be added to address specific questions or additional data needs. Data from these surveys, which are archived in the Site ecological database, have been used in the preparation of compliance documents, environmental evaluations, remediation plans, environmental assessments, environmental impact statements, categorical exclusions, and project planning documents. These data are also used to make ecological resource management decisions to ensure the preservation of these resources at the Site. Since the ecological monitoring program deals with a large and dynamic natural system, where established endpoints do not exist, a qualitative, rather than statistical approach was adopted in the Annual Wildlife Survey Reports (RMRS 1995d, 1996d), (Exponent 1998, 1999), (K-H 2000c, 2001b).

No remarkable changes in population estimates, census data, monitoring results, or relative abundance of species, or other measures were discovered through monitoring efforts. All data indicate that the majority of the ecosystem in the outer portions of the Site is not influenced substantially by actions within the Industrial Area. As long as these habitats and plant communities remain undisturbed and reasonable and prudent management actions are taken to maintain the health of the ecosystem, no significant adverse effects are likely to result from current Site operations.

Contaminant Surveys in Wildlife and Vegetation

Many studies have been conducted concerning the uptake of plutonium into vegetation and wildlife from soils located on Rocky Flats. All study results on vegetation show that there is minimal uptake by the root system. It was also found that the majority of plutonium contamination is deposited on the plants by air deposition and rainsplash (Deng 1992, Jarvis 1991, and Arthur and Alldredge 1982). Thomas and Ibrahim (1995) determined that the distribution of ^{239,240}Pu in lichens have a distance and directional component similar to soil and that lichen plutonium concentrations are correlated to soil concentrations. Little, Whicker, and Winsor (1980) looked at the grassland ecosystem as a whole. They were able to demonstrate that more than 99 percent of the plutonium inventory was in soil while less than 0.3 percent of the inventory was in the plants and small animals. They estimated that small animals and arthropods average 100 times lower concentrations of Pu than the surrounding soil and that those concentrations are much lower than those which produced biological effects in laboratory dogs and rodents.

The latest mule deer study was conducted in 1992 by Symonds (Symonds 1992). She took tissues from 7 roadkill dear that were known to inhabit the buffer zone. All tissue analysis was below detection limits. Symonds also determined that the does and fawns that were radiotracked inhabited the Walnut Creek and Woman Creek areas about 50 percent of the time in winter and about 35 percent in the summer.

Although these studies show there is uptake into the plants and animals at the Site, concentrations remain below levels that those shown to produce biological effects in laboratory dogs and rodents. A recommendation would be to study tissue plutonium levels and intake ratios for plants and animals (including birds) in the industrial area, since these have not been studied yet and that is where the majority of contamination resides. In addition, the effects of other contaminants of concern need to be looked at in plants and animals, as well.

7.2.4 Air Monitoring Data Review

Air monitoring for radionuclides, beryllium, criteria pollutants and volatile organic compounds have been performed at RFETS during the last five years (K-H, 2000b).

Radionuclides

Results for radionuclides are contained the in the RFETS annual reports to the EPA and the CDPHE, as required by the National Emission Standard for Emissions of Radionuclides from Department of Energy Facilities, 40 CFR 61, Subpart H (DOE 1997-2000). Additional radionuclide monitoring data are also available from environmental restoration and D&D project (performance) monitoring by RFETS and CDPHE (URS Corp. 2001), and the CDPHE Air Pollution Control Division (APCD) and Laboratory and Radiation Services Division (LARSD) monitoring networks.

Since 1998, data for the Subpart H annual reports have been obtained from a network of fourteen high-volume air samplers at the RFETS perimeter. These samplers are part of a 39 station network located in the industrial area, buffer zone, off-site and perimeter. Filters from these samplers are collected monthly, analyzed for plutonium (Pu-239/240), americium (Am-241) and uranium (U-233/234, U-235 and U-238) and the data summarized in the annual reports. These samplers do not monitor for tritium. Instead, the tritium contribution, which is less than one percent of the RFETS off-site emissions, has been determined by effluent monitoring and modeling.

Prior to 1998, data for the Subpart H reports were obtained from modeling stack emissions from the plutonium buildings and resuspended radionuclides from contaminated soil. The 1998 and 1999 annual reports contained data from both modeling and the perimeter network. Subpart H limits the emissions of radionuclides to the atmosphere to 10 millirem effective dose equivalent per year for the maximum exposed individual (MEI) member of the public.

The Annual Reports for 1997 through 2000 show that the maximum dose to the MEI was less than 1.5% of the allowable 10 millirem limit, and that the vast majority of this dose was caused by airborne dispersal of naturally-occurring uranium isotopes. As an example, the Annual

Report for 2000 concludes that plutonium contributed only 2.2% of the total dose that would have been received by the MEI, while americium contributed 4.5%. Data for the 2001 Annual Report, which will be completed in June 2002, show results similar to the previous four years.

RFETS performance air monitoring results from environmental restoration and D&D projects are also contained in the annual Subpart H reports and in project air monitoring reports. Data for RFETS D&D performance air monitoring is obtained from a network of ten monitoring locations surrounding the industrial area. Filters from these monitors are checked weekly for long-lived gross alpha (alpha after allowing time for radon decay). Action levels are set for long-lived gross alpha that have the potential to cause dose to the MEI at the rates of 1 and 5 millirems per year based on modeling. CDPHE performance air monitoring was also conducted with total suspended particulate high volume monitors arranged in a close in network around Building 111 during demolition (CDPHE, 2002).

RFETS performance monitoring has shown that environmental restoration/D&D projects have not made a significant contribution to the measured concentrations or modeled dose in the last five years. The CDPHE performance monitoring was conducted to establish a baseline for future performance monitoring. The results of the monitoring also showed that obtaining laboratory results quickly (i.e. within hours or a few days) is not possible for radionuclide isotopes analysis and that the 0.1 millirem dose to the MEI action level is too close to background levels to practically implement.

Data for the APCD monitoring network are obtained from a perimeter network of five monitoring stations and data for the LARSD is obtained from the network of industrial area, buffer zone and perimeter monitoring locations. The LARSD network was reduced to two active and four screening buffer zone and industrial area locations in 2001. APCD discontinued particulate and radionuclide monitoring at the five perimeter stations in June 2001. LARSD then assumed the duties for radionuclide monitoring at these five sites.

CDPHE APCD annual report results are consistent with the RFETS perimeter network results. LARSD results show a trend of elevated plutonium levels in the winter at a location east of the 903 Pad, which is consistent with RFETS results. Strong, persistent westerly winds and low precipitation appear to correspond to these elevated levels. However, modeling demonstrates that these levels are well below the Subpart H limit.

Beryllium

Results for beryllium air monitoring are contained in the CDPHE APCD annual reports "Air Monitoring Data Report on the Rocky Flats Monitoring Network" (CDPHE, 1997 – 1999) and the "Performance Monitoring for Baseline Development: Building 111" (K-H, 2002) presentation by Kaiser-Hill. Data for the APCD annual report were obtained from the five station CDPHE APCD monitoring network, and data for the Kaiser-Hill presentation were obtained from a close-in monitoring network that was operated during the demolition of Building 111. The Building 111 performance monitoring was done to establish an RFETS background for ambient beryllium for use in future project monitoring. Building 111 had no history of beryllium use.

The alternate National Emission Standard for Beryllium (40 CFR 61, Subpart C) in ambient air is 0.01μg/m^3 averaged over a 30 day period. The basic standard is 10 grams per 24 hour period based on stack monitoring. Results from the Building 111 monitoring show average ambient levels at 1E – 05 μg/m^3 or about 1,000 times less than the Subpart C standard. Values ranged from non-detect to 1E – 04 μg/m^3. CDPHE APCD monitoring indicated all results less than the detection limit for beryllium.

Criteria Pollutants and Volatile Organic Compounds

Criteria pollutant and VOC air monitoring data are contained in the CDPHE APCD annual reports "Air Monitoring Data Report on the Rocky Flats Monitoring Network". These reports contain data from the CDPHE APCD perimeter network for the following criteria pollutants: particulate matter 10μm and smaller, oxides of nitrogen and ozone. In addition to VOC, total suspended particulates, and radionuclides and beryllium (discussed above) results are included in the reports.

Levels for criteria pollutants were all below the National Ambient Air Quality Standards except for ozone, which was at the new 8 hour standard. (The ozone results were for 1999, the latest available report.) Ozone monitoring is not required at RFETS, but is part of the CDPHE APCD monitoring network in the Denver area. Levels for VOCs were below the threshold limit values, and levels for total suspended particulates were below the former National Ambient Air Quality Standards. In 2001, the CDPHE LARSD took over responsibility from APCD for radionuclide monitoring at the perimeter network and other monitoring, except for ozone and meteorology, which were discontinued.

7.3 Remedy Cost

In 1994 the mission of RFETS changed from a production mission to one of safe cleanup and closure. This was followed in 1997 by the site's official designation as a closure site. The budget estimate prior to the closure site designation to safely cleanup and close the site was approximately $32 billion, with closure scheduled in 2013. In January of 2000 an incentive based closure contract was signed to clean up and close the site by December 2006 for $3.963 billion (not including incentive fee). As of September 30, 2001 closure is estimated to be 24% complete with 24% of the estimated budget consumed.

8.0 Technical Assessment

The technical assessment section of the report uses information gathered during the review process to answer three key questions.

Question A "Is the remedy functioning as intended by the decision document?"

Question B "Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?"

Question C "Has any other information come to light that could call into question the protectiveness of the remedy?"

RFETS has not yet established a site-wide remedy or CAD/ROD. The site-wide remedy is being developed as a culmination of the RI/FS process. However, a CAD/ROD has been completed for OU 1 and OU 3. Further, several accelerated actions have been completed to mitigate immediate hazards. This section will answer the three key questions for OU 1 and OU 3 and for accelerated actions completed through the end of FY 2001. For the accelerated actions, the remedy analyzed is the action taken to mitigate the immediate hazard and may or may not be the final remedy included in the site-wide CAD/ROD.

8.1 Access and Institutional Controls

RFETS has a multi-tiered access control program in place that governs all activities. The entire site is fenced with 24-hour security to prohibit unauthorized access. Barriers, signs, and a work control and work planning process further control access to individual sites. Only individuals with proper training are allowed access to sites that may pose a health risk. In addition, the site maintains a soil disturbance permit process, which prevents excavation in potential areas of concern or IHSSs without proper planning. Proposed excavations sites are evaluated based on process knowledge and contamination data contained in the Soil/Water Database and elsewhere. If sufficient characterization information is not available, additional sampling is required prior to excavation.

The nature and extent of access and institutional controls will change when RFETS transitions from a closure site to a long-term stewardship site. At closure, most of the site will be transferred to the U.S. Fish and Wildlife Service for management as a national wildlife refuge. DOE and the Fish and Wildlife Service are currently negotiating a memorandum of understanding, which will outline the process governing this transfer. In addition, a Comprehensive Conservation Plan is being developed that will take into account mandated restrictions in relation to the final remedy. Restrictions mandated by the final CAD/ROD will be enforced by the DOE as lead federal agency under CERCLA and by the State under RCRA.

8.1.1 Technology Evaluation

RFCA paragraph 254 requires a review of advances in technology in order to reduce the dependence of a remedy on institutional controls. A technology review was not conducted for this first review because final post cleanup institutional controls have not been established. However, DOE recognizes that a technology review will be appropriate for future Five-Year Reviews. This section of the report is included as a placeholder to ensure that a review of advances in technology is conducted during future Five-Year Reviews.

8.2 Monitoring and Operations and Maintenance

RFETS also has in place contractor-operated programs for monitoring, and operation and maintenance (O&M) of facilities, including remedial action structures and systems. The necessary operational or maintenance requirements for each system are defined in the system design documents and closeout report, and monitoring requirements are incorporated into the remedial decision document, closeout report and the IMP. O&M activities are tracked through

the Plant Action Tracking system. Monitoring results are reported in the quarterly and annual monitoring reports, and maintained on the Environmental Data Dynamic Information Exchange web based database.

8.3 Individual Sites Analyzed

Sites analyzed in this five year review include: OU 1, 881 Hillside, OU 3, Off-Site Areas, Trench T-1, Trench T-2 (Ryan's Pit), Trenches T-3 and T-4, the Mound Site, the East Trenches Reactive Barrier, the Mound Reactive Barrier, the Solar Pond Reactive Barrier, Solar Ponds Sludge Removal Action, OU 7 Seep, and the Underground Storage Tank Accelerated Action. The protectiveness of the remedies and accelerated actions is analyzed in the following sections. Each of the three questions provided in the EPA guidance are answered for the specific sites analyzed.

8.3.1 Selected Remedy and Analysis Of Operable Unit 1

Monitoring Information

Groundwater monitoring of the OU 1 IM/IRA has been in effect since the remedy was completed in 1992. Since 1997, monitoring activities at Rocky Flats have been consolidated in the site wide IMP. By using the data quality objectives approach, ten groundwater wells are sampled on a semiannual basis to provide the data necessary to evaluate the performance of the French drain and to track the levels of contaminants in groundwater upgradient of the French drain. Since the OU1 IM/IRA was installed, the plume of VOC contaminated groundwater originating from IHSS 119.1 has not migrated downgradient of the French drain. Several of the wells downgradient of the French drain are usually dry. Contaminant concentration levels inside the plume are slowly decreasing, due in part to the collection and treatment of groundwater from the collected well. In the past year, TCE, the major contaminant of the plume, has dropped below the Tier 1 Action Level of 500 parts per billion in the collection well. This corresponds to a downward trend in concentration of VOCs from this well since 1994. Likewise, VOCs in other wells have been slowly decreasing and are now an order of magnitude lower than they were 5 years ago (RMRS 1997b).

The French drain itself probably was not responsible for limiting the downgradient migration of this plume. The apparent lack of migration has most likely occurred naturally due to a combination of factors, such as limited groundwater in the area, limited source of contamination; and the clay rich stratigraphy that limits groundwater movement in the area. Analytical results of the groundwater collected in the French drain do not show detectable amounts of VOCs (RMRS 1997b).

Summary

The original and modified remedy for IHSS 119.1 include the following:

1 Downgradient investigation; DOE has performed confirmatory soil sampling downgradient of IHSS 119.1 to verify that a significant contamination source does not exist there.

2 Groundwater extraction and treatment; Groundwater will continue to be extracted from the Collection Well and transferred to the existing Building 891 treatment system for final treatment and discharge through April 2002. (Based on groundwater monitoring results, treatment in Building 891 was discontinued in April 2002.)

3 Groundwater monitoring; Groundwater monitoring will continue at IHSS 119.1, consistent with the IMP, after the groundwater pumping is complete.

4 Institutional Controls; Institutional controls will be maintained throughout OU 1 area in a manner consistent with restricted open space land use and that domestic use of groundwater is prevented.

Conclusion

EPA Guidance for conducting a CERCLA five-year review provides three questions that should be addressed:

Question A: Is the remedy functioning as intended by the decision document?

Implementation of the modified remedy for OU 1 is functioning as intended.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

The action levels established in ALF are undergoing review by the RFCA Parties, due to changes in the exposure pathway expected with a wildlife refuge worker scenario and changes to the exposure parameters for other scenarios. Although no change is expected for the remedy at OU 1, existing cleanup levels and objectives will have to be reviewed based on any new cleanup levels and goals.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No additional information has come to light that will affect the protectiveness of the remedy.

Implementation of the modified remedy for OU 1 is protective of the human health and the environment and is functioning as intended.

8.3.2 Operable Unit 3, The Offsite Areas

Scope and Results of Review

The language of the OU 3 CAD/ROD Declaration Statement implies that no five-year review of the selected remedy is required at this time, since no national health-based standards for the COC (i.e., plutonium and americium) have been promulgated. However, DOE, EPA and CDPHE believe that a five-year review is appropriate, given the high level of historic and ongoing public interest in OU 3. A review is also appropriate in light of the information developed since the

signing of the OU 3 CAD/ROD by the RFCA parties, with public involvement, during the review of the RSALs.

This Five-year Review for OU 3 will focus on two topics:

1) environmental data from or related to OU 3 collected in the past five years; and,
2) analysis of the newly calculated risks posed by plutonium and americium in surface soils (done as part of the RSAL review process), as compared with known levels of contaminants in OU 3.

The first topic examines whether additional, significant contamination could have moved into OU 3 over the past five years, and whether conditions in OU 3 have changed significantly as a result. The second topic compares the RSAL calculations with historic OU 3 data, to determine whether the exposure assumptions and toxicity data used as a basis for the OU3 CAD/ROD remain valid.

Environmental Conditions in OU 3

As stated earlier, the OU 3 CAD/ROD concluded that transport by wind and water were the primary means by which plutonium and americium were carried to OU 3. Therefore, DOE reviewed available air and water monitoring data from OU 3 and at the RFETS boundary to determine whether significant contamination could have moved into OU 3 since the CAD/ROD was signed. Air monitoring data from the RFETS perimeter air monitoring network were analyzed as part of this review. Water monitoring data from the RFCA POCs on Woman and Walnut Creeks at Indiana were analyzed, as were data collected by the City of Broomfield for Great Western Reservoir. Discussions with the City of Westminster and the Woman Creek Reservoir Authority revealed that those entities had not collected data on plutonium and americium from Standley Lake and Woman Creek Reservoir, respectively, since the OU 3 CAD/ROD was signed.

A detailed discussion of air monitoring results can be found in section 7.2.4. Based on these results, DOE concludes that the amounts of plutonium and americium that have been measured in air at the RFETS perimeter since 1997 have been environmentally insignificant. These amounts of plutonium and americium would not have caused contaminant levels in OU 3 to change significantly since the CAD/ROD was signed.

DOE concludes, on the basis of water quality results from Walnut Creek, Woman Creek and Great Western Reservoir that significant amounts of plutonium and americium have not entered OU 3 through the water pathway since the CAD/ROD was signed. DOE does not believe that environmental conditions in OU 3 have changed significantly as a result.

Comparisons with Recent RSAL Risk Calculations

Recently, DOE, EPA and CDPHE have calculated values for prospective new RSALs (DOE 2001b). These calculations have resulted in a range of values, corresponding to various risk and dose levels, and employing several different land use scenarios. One land use scenario used in the recent RSAL calculations, the rural resident scenario, was substantially similar to the

residential scenario used in the HHRA. Both scenarios anticipated people living on contaminated areas of Rocky Flats, with exposures to plutonium and americium resulting from ingestion of contaminated soil, inhalation of dust, consumption of homegrown produce, and exposure to external gamma rays given off by the contaminants. The recent RSAL calculations anticipated that periodic wildfires on contaminated areas of Rocky Flats would increase exposures through increased inhalation of particulates, a scenario not envisioned in the HHRA. Both scenarios considered reasonable maximum exposures, and both considered the additive effects of plutonium and americium.

For the rural resident scenario, the preliminary RSAL calculations predict that a plutonium soil concentration of 2 pCi/g would result in an excess cancer risk of one in one million ($1x10^{-6}$). The highest plutonium concentration observed in soils in OU 3 was approximately 6.5 pCi/g, which results in an excess cancer risk of about three in one million ($3x10^{-6}$) for the rural resident scenario, using the recent RSAL calculations. This is almost exactly the same risk calculated for the residential scenario in the HHRA, and falls well within the risk range that is considered by EPA to be protective of human health.

From the perspective of radiation dose, a soil plutonium concentration of 6.5 pCi/g would give an adult rural resident an annual dose of 0.78 millirem, using the recent RSAL calculations. The OU 3 HHRA calculated that the annual dose received by a resident from this level of plutonium in soils would be 0.12 millirem. Neither of these exposures is meaningful from a human health perspective, and the difference between the two calculated values is insignificant, especially considering that the average annual radiation dose in Colorado from natural and man-made sources is about 420 millirem per year. These calculated doses also compare favorably with EPA's draft decommissioning rule of 15 millirem per year, and the subsequently promulgated Nuclear Regulatory Commission and State of Colorado radiation site cleanup regulation of 25 millirem per year for unrestricted use.

Summary and Conclusions

In preparing this five-year review, DOE examined environmental conditions in OU 3 to determine whether there was evidence that new contamination had been introduced to OU 3 that might warrant additional action. DOE also compared data from the OU 3 RFI/RI report with recent RSAL calculations to determine whether the levels recorded in the RFI/RI report were still protective in light of recent calculations.

DOE found no evidence that significant new contamination could have been introduced to OU 3 from Rocky Flats. Ambient air monitoring performed at the Rocky Flats perimeter shows airborne concentrations of plutonium and americium to have been insignificant. Samples of water leaving Rocky Flats have shown consistently low concentrations of plutonium and americium, demonstrating consistent compliance with RFCA water quality standards. Water samples from Great Western Reservoir have consistently been at or below detection levels for plutonium and americium.

Human health risks calculated using the OU 3 RFI/RI Report environmental data and the scenarios employed in the recent RSAL calculations were virtually identical to those calculated

in the OU 3 HHRA. These risks are well within the risk range considered protective of human health. The scenarios (rural resident for the RSAL's and residential for the OU 3 HHRA) were substantially similar in both calculations. The annual radiation dose rates calculated in the OU 3 HHRA, and calculated using the RSAL scenarios, were comparable (both were less than 1 millirem per year) and insignificant from a human health perspective.

Based upon the information contained in this five-year review, DOE concludes that the remedy selected for OU 3 continues to be effective, and that conditions in OU 3 are protective of human health and the environment. No additional actions are warranted in OU 3. DOE will conduct another review of the OU 3 CAD/ROD in five years, if environmental conditions and/or changes in regulatory requirements (such as promulgation of a national health-based standard for the COCs for OU 3) indicate the need for such a review.

EPA guidance for conducting a Five-Year Review provides three questions that should be addressed:

Question A: Is the remedy functioning as intended by the decision document?

Yes, since the remedy is a no remedial action remedy.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Yes. Although exposure assumptions and RSALs are currently being reevaluated in accordance with RFCA, any changes to RSALs should not impact the protectiveness for OU 3. No additional action is warranted for OU 3.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No additional information has come to light that affects the protectiveness of the remedy of no remedial action.

8.3.3 RFETS Trench-1 Source Removal

Verification of Source Removal

In accordance with the T-1 Sampling and Analysis Plan (RMRS 1998b), soil samples from the floor and side walls of the trench excavation were collected and analyzed for radionuclide and non-radionuclide COCs. The analytical results indicated that for all COCs concentrations were well below RFCA Tier II action levels, and that sum-of-ratios values were less than one, which is an indicator for evaluating risk posed by the collective summation of radionuclides. These results indicated, with satisfactory statistical confidence, that contaminants previously in the trench have been successfully remediated relative to RFCA action levels (See table 4-3 of the Closeout Report) (RMRS 1999b). A summary of table 4-3 from the Closeout Report is included as Table 9 below.

In addition, two stockpiles were used to support T-1 excavation activities. Each stockpile was segregated and filled with excavated soil based on radiological field screening of the soil. Previous remedial activities at Rock Flats indicated that soil segregated based on screening results below 5,000 counts per minute using a Field Instrument for the Detection of Low energy Radiation were likely to have concentrations for radionuclides below the RFCA Tier II action level. The other soil stockpile was used to see if soil above 5,000 counts per minute (i.e., 5,000-10,000) would also fall below the appropriate RFCA action-levels, thus reducing the volume of soil requiring packaging and offsite disposal. The two stockpiles were sampled following excavation. It was found that for the clean stockpile, the sum-of-ratios resulted in a value significantly less than one. (See Table 9 below.) This indicated that the soil stockpile, in total, was satisfactory for return to the excavation. Additionally, no volatile organic compounds were detected in any of the samples. (RMRS 1999b)

Table 9 Summary of Radionuclide Analysis for Clean Soil Stockpile based on 16 Samples

	Am-241 (pCi/g)	Pu-239/240 (pCi/g)	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)		
Mean Value	0.79	3.47	20.38	0.45	20.48		
Standard Deviation	0.49	2.17	20.07	0.29	20.07		
Variance	0.24	4.72	402.79	0.08	402.79		
Tier I	215	1429	1738	135	586		
Tier II	38	252	307	24	103		
						Tier I Sum-of Ratios	Tier II Sum-of-Ratios
Normal 95% UCL	1.01	4.46	29.51	0.58	29.51	0.08	0.45
Log Normal 95% UCL	1.04	4.56	40.57	0.64	40.57	0.11	0.60

The soil placed in the second stockpile (5,000-10,000 counts per minute) was found to be at the Tier I action level and approximately five times the Tier II action level for radionuclides. As a result, this soil was not considered acceptable for return to the excavation and was subsequently packaged into containers and disposed offsite.

Protectiveness Summary

Question A: Is the remedy functioning as intended by the decision document?

Yes. The accelerated action is functioning as intended by the PAM. In the case of Trench 1, the intent of the remedy was to remove depleted uranium and/or soils above RFCA Tier I action levels for radionuclides or VOCs. The primary objective of the project was to remove drummed

waste and debris, and contaminated soils. A review of confirmation sampling results after project completion demonstrates the source has been removed. However, the third objective, to disposition the waste that was generated, was not completely met. There is currently no treatment option available for depleted uranium contaminated with PCBs. Treatment options are being investigated.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Yes. However, the action levels and RSALs established in ALF are in the process of being updated. Cleanup levels will have to be reviewed if new RSALs are established.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No.

Conclusion

The Trench 1 removal was successfully completed.

Recommendations and Follow-up Actions:

Continue to pursue treatment options for the remaining stored T-1 waste.

8.3.4 Source Removal at IHSS 109, Ryan's Pit, Trench 2

Verification of Source Removal

The objective of the excavation was to remove the source material from the trenches, treat it, and backfill the treated soil into the excavation. Once visible contamination was removed from the excavation and the area excavated to native material on the floor and walls, ten confirmation samples were collected for analysis of VOC and radionuclides. The SAP defined the PPRG subsurface soil construction worker scenario as the clean up criteria for the project (RMRS 1995e). All confirmation samples met the cleanup criteria defined for this source removal.

Each batch of soil was sampled before and after treatment. Batches 21, 22, 31, and 35 exceeded the treatment performance standards. These batches had already been placed into decontaminated roll-off containers with other batches; therefore, the entire roll-off container had to be retreated. All samples collected from the retreated batches met the performance standards. Three composite samples were collected from each roll-off container and analyzed using a high purity germanium detector. Results were compared with the RFCA Tier I and Tier II subsurface soil action levels for radionuclides. All samples met the requirements stipulated by EPA, CDPHE, and DOE, as stated in the PAM Modification. A Closeout Report was prepared to demonstrate that all requirements in the PAM Modification were met (RMRS 1997e). See Table 10 below for a summary of soil excavation and treatment results.

Table 10 Ryan's Pit Soil Excavation and Treatment Results

Compound	PPRG[1]	Tier I Subsurface Soil Action Level[2]	Confirmation Samples From Excavation Pit (Maximum Value) (mg/kg)	Post-Treatment Process Verification Samples (Maximum Value) (mg/kg)
1,1-dichloroethane	53000	689	0.018	0.005 (J)
1,1,1-trichloroethane	2180	1.23	0.002 (J)	0.910 (E)
Trichloroethene (TCE)	5120	3.28	19	0.54 (J)
Tetrachloroethene (PCE)	2210	3.15	250	9.9
Toluene	116000	707	100	4.0 (B)
Ethylbenzene	148000	932	28	2.4
Xylene (total)	>100%	9740	140	16 (B)

1. The Programmatic Preliminary Remediation Goals (PPRGs) are based on construction worker, subsurface soil scenario, Rev 3., August 1995.
2. Protective of 100 x Maximum Contaminant Levels or PPRGs in groundwater, RFCA Attachment 5, March 21, 2000.

(J) = Compound found but is below practical quantitation limit. Quantitation is estimated.
(E) = Compound is detected, but is off scale and therefore estimated.
(B) = Compound detected in blank.

Protectiveness Summary

The purpose of the accelerated action was to remove VOC contaminated soil, treat the soil utilizing low-temperature thermal desorption and back fill the excavation with the treated soil.

A review of the groundwater monitoring results was conducted to evaluate the effectiveness of the source removal. Well 07391 is the closest downgradient well to the source removal area. A detailed discussion of VOC and uranium results since this well was first sampled in March 1992 can be found in the 2000 Annual RFCA Groundwater Monitoring Report (RMRS 2001).

To summarize the report findings, concentrations of VOCs emanating from Ryan's Pit have generally remained constant with time. In contrast, sampling and analysis of U-isotopes such as U-235 and U-238 show an upward trend to the uranium activity since the source removal activity. The flat VOC trend and the upward uranium trend since the source removal is not necessarily surprising. Ryan's Pit was used between 1966 and 1970. Contamination from the pit would have moved beyond the pit boundaries prior to the source removal in 1995 and 1996. Groundwater travels slowly and it is likely that it will take several more years before a contaminant downward trend is observed. In fact, it is not uncommon that excavation activity

will actually free up contaminants previously tied up with the soil matrix and an upward data trend is observed. This appears to be the case with U-235 and U-238. Uranium results are close to background despite the apparent upward trend. There is no apparent pathway for the groundwater to impact surface water. Monitoring of well 07391 will continue in accordance with the IMP.

Question A: Is the remedy (accelerated action) functioning as intended by the decision documents?

Yes. Soils were excavated to below the August 1995 PPRGs and treated to the PAM/Permit Modification performance standards. Further groundwater monitoring will continue in accordance with the IMP.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

The action levels established in ALF are undergoing review by the RFCA Parties, due to changes in the exposure pathway expected with a wildlife refuge worker scenario and changes to the exposure parameters for other scenarios. Although no change is expected for the accelerated action at Ryan's Pit, existing cleanup levels and objectives will have to be reviewed based on any new cleanup levels and goals.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy (accelerated action)?

No.

8.3.5 Source Removal at Trenches T-3 and T-4 IHSSs 110 and 111.1

Verification of Source Removal

The objective of the excavation was to remove the source material from the trenches. This required excavating until soil concentrations in the trench were below the cleanup values listed in table 11 below. In the case of T-3, excavation to a depth of approximately 15 feet was required to ensure VOC source removal. For T-4 the excavation depth was approximately 12 feet with the exception of three area where excavation to bedrock at a depth of approximately 26 feet was required. The material from the excavation was then treated in a thermal desorption unit to below accepted performance standards also listed in Table 11.

Table 11 Excavation Cleanup Values and Thermal Desorption Unit Performance Standards

Contaminant	Excavation Cleanup Values (ppm)	TDU Performance Standards (ppm)	Detection Limit (ppm)
1,1,1-TCE	378	6.0	0.6
1,1 –DCE	11.9	6.0	0.6
1,2-Dichloroethane	6.33	6.0	0.6
1,2-Dichloroethene	9.51	-	0.62
Acetone	-	160	1.2
Benzene	-	10	0.6
Carbon tetrachloride	11	6.0	0.6
Chloroform	152	6.0	0.6
Ethylbenzene	1760	10	0.6
Methylene chloride	-	30	0.6
PCE	11.5	6.0	0.6
Toluene	2040	10	0.6
TCE	9.27	6.0	0.6

The primary objective of the project was to remove VOC source material; however, radiocuclide contamination was screened as part of the project as well. Soil was initially screened using a Field Instrument for the Detection of Low Energy Radiation, then analyzed using laboratory gamma spectroscopy after treatment was complete. The results of the isotopic characterization are presented in Appendix D of the Closeout Report (K-H 1996) and indicate that all soil, including the material initially segregated as potentially radionuclide contaminated met the RFCA ALF Tier I subsurface action levels. (See Table 5 in section 4.5 of this report for Tier I action levels used for the T-3/T-4 project.) Furthermore, all but approximately 250 cubic yards of soil met the Tier II values as well. Consequently, all treated soil was returned to the excavation. The 250 cubic yards of soil between Tier I and Tier II was wrapped in a burrito wrap with its location noted in the event it becomes necessary to remove this soil in the future.

Protectiveness Summary

A review of the groundwater monitoring results was conducted to evaluate the effectiveness of the source removal. Results from upgradient well 12191 and downgradient wells 3687, 05691, 11891, and 12691 are discussed in detail in the 2000 Annual RFCA Groundwater Monitoring Report (RMRS 2001).

To summarize the report's findings, concentrations of PCE, TCE, and chloroform decreased downgradient of Trenches T-3 and T-4 in wells 11891 and 3687 prior to the accelerated source removal action. Since the source removal action, concentrations of these three contaminants have remained essentially unchanged. A statistically significant yet small increase in carbon tetrachloride concentrations has occurred in downgradient well 11891 since source removal in 1996. The relatively flat VOC trend since the accelerated source removal action is not necessarily surprising. Trenches T-3 and T-4 were used between 1964 and 1967 and VOC contamination would have moved beyond the boundaries of the trenches prior to the source removal action. Further, it is clear from the upgradient results that Trenches T-3 and T-4 are not the only source of VOC contamination in this area. It is not uncommon that a source removal excavation will actually free up contaminants previously tied up in the soil matrix. Monitoring of wells near T-3 and T-4 will continue until VOC concentrations decrease to an acceptable level and in accordance with the IMP.

Groundwater from T-3 and T-4, and from the entire East Trenches Plume is being addressed by the East Trenches Reactive Barrier. This barrier is in place to prevent the East Trenches Plume from potentially impacting surface water.

Question A: Is the remedy functioning as intended by the decision document?

Yes. Contaminated soil was removed, treated, and returned to the excavation in accordance with the objectives of the PAM. Monitoring will continue in accordance with the IMP.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Yes. However, the action levels established in ALF are undergoing review by the RFCA Parties, due to changes in the exposure pathway expected with a wildlife refuge worker scenario and changes to the exposure parameters for other scenarios. Although no change is expected for the accelerated action at T-3 and T-4, existing cleanup levels and objectives will have to be reviewed based on any new cleanup levels and goals.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No

8.3.6 Source Removal at Mound Site (IHSS 113)

Verification of Source Removal

Approximately 724.5 cubic yards of soil were excavated from the Mound Site, and treated using Low Temperature Thermal Desorption. The treatment process was successful in meeting the performance goals as stated in the PAM. The backfill of treated soil at the excavation site was completed in September 1997. The Closeout Report for the Source Removal at the Mound Site IHSS 113 was completed in October 1997. Table 12 below provides a summary of the range of treated soil VOC concentrations returned to the Mound Site excavation. A summary of the Mound Site process verification sample information is found in Appendix B and analytical results are in Appendix C of the Closeout Report (RMRS 1997d).

Table 12 Post Thermal Desorption Concentrations for the Mound Site

Contaminant	TDU Performance Goal (ug/kg)	Low Concentration (ug/kg)	High Concentration (ug/kg)
PCE	6000	625 U	630 U
TCE	4000	625 U	630 U
Methylene Chloride	5770	300 J,B	3000*
Carbon Tetrachloride	2000	625U	630 U

U= detection limit, contaminant was not detected at or above this level
J= estimated concentration
B= contaminate was found in the blank
*= methylene chloride detected in associated trip blank, therefore considered undetected

Following excavation, sidewall sampling, additional soil was removed from the bottom of the excavation such that the excavation proceeded past the highly weathered claystone bedrock, located immediately below the alluvial/bedrock contact. Fourteen areas were sampled from the excavation bottom. Results from two of the 14 samples exceeded the VOC cleanup target levels for excavation stated in the PAM. Both samples exceeded the 11.5 mg/kg cleanup target level for PCE. These results were discussed with EPA and CDPHE and it was decided that because the majority of contaminated soil had been removed, the difficulty of excavation deeper into the bedrock, and the limiting conditions established in the PAM had been met, excavation activities would cease.

In another accelerated action conducted in 1998, a passive reactive groundwater barrier and treatment cell was installed downgradient and north of the Mound Site to capture and treat groundwater contaminated with chlorinated organic compounds and low levels of radionuclides at the distal end of the plume. (See sections 4.7 and 8.3.7.)

Well 00897, downgradient of the Mound Site, contain PCE concentrations fluctuating within the mean concentration of 16,671 micrograms per liter. It appears to exhibit a slightly upward trend. TCE in Well 00897 decreased slightly. Samples of both the PCE and TCE in Well 00897 exceeded Tier I levels. Well 02291, also downgradient of the Mound Site, has PCE concentrations above Tier I action levels. PCE seems to fluctuate along the mean concentrations of 3,124 micrograms per liter, and they appear to be increasing over the long term slightly. TCE mean concentration is 397 micrograms per liter and indicates a slightly increasing trend. Monitoring will continue at Well 00897 and Well 02291 until VOC concentrations decrease to an acceptable level in accordance with the IMP.

Protectiveness Summary

Question A: Is the accelerated action functioning as intended by the decision document?

Yes. However, not all the source was removed due to the excavation proceeding past the highly weathered claystone bedrock, located below the alluvial/bedrock contact. Any residual VOC contamination not removed during this accelerated action is being address by the Mound Plume Reactive Barrier accelerated action.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the accelerated action still valid?

Yes. However, the action levels established in ALF are undergoing review by the RFCA Parties, due to changes in the exposure pathway expected with a Wildlife Refuge worker scenario and changes to the exposure parameters for other scenarios. Although no change is expected for the accelerated action at the Mound Site, existing cleanup levels and objectives will have to be reviewed based on any new cleanup levels and goals.

Question C: Has any other information come to light that could call into question the protectiveness of the accelerated action?

No.

Conclusions

The Mound Site source removal action was completed as agreed to in the PAM. The remaining source and the Mound Site groundwater plume is currently being remediated as part of the Mound Plume passive reactive barrier and treatment accelerated action.

8.3.7 Mound Plume Reactive Barrier

Verification of Source Removal

Analytical results and aquifer water level monitoring indicate the treatment system is effectively capturing the plume and removing the VOCs and radionuclides identified as the COCs in the decision document for the accelerated action. Monthly analytical sample results are detailed in the quarterly and annual Groundwater Plume Treatment Systems Reports. These sample results are summarized in Table 13 below.

Table 13, Summary of Mound Plume Fiscal Year 2000 Analytical Results

Contaminant	Influent (R1I) Concentration (µg/l)	Reactor 2 Effluent (R2E) Concentration (µg/l)	RFCA Groundwater Tier II Action Levels (µg/l)
Trichloroethene	74-76	ND	5
Tetrachloroethene	44-50	ND	5
Carbon Tetrachloride	73-130	ND	5
Chloroform	20-23	ND-0.6J	100
Cis 1,2-Dichloroethene	23-38	0.26J-3	70
1,1-Dichloroethene	5-5.1	ND	7
1,1-Dichloroethane	1.2-2J	0.63J-2	3,650
1,2-Dichloroethane	ND-0.59J	ND	5
Methylene Chloride	ND	ND –6	5
1,1,1-Trichloroethane	3.4-4	ND	200
p-Dichlorobenzene	ND-0.34J	0.24J	75
Total Uranium (pCi/l)*	15.03	0.19J	2.84

J = Detected at concentrations below the detection limit for this analysis
ND = Not detected at the detection limit for this analysis
pCi/L = picoCuries per liter

Many of the contaminants entering the treatment system are probably degradation products from tetrachloroethene and carbon tetrachloride. The p-dichlorobenzene might be a laboratory cross-contaminant because it is probably neither a solvent nor a degradation product. At this time, there does not appear to be any evidence that the iron is being depleted, demonstrating the long-term treatment capability that was anticipated in the design of project.

As stated in the Decision Document (DOE 1997d), the collection system was installed near South Walnut Creek to capture the contaminated groundwater to the extent practicable. Analytical samples are collected from three wells that are located downgradient of the collection trench. The downgradient wells are located within the cut-off downgradient portion of the plume, which was not intended to be treated. Analytical results from these wells are summarized in Table 14 below.

Table 14, Downgradient Well Analytical Results (in μg/l unless otherwise noted)

Well	15699		3586		RFCA Tier II ALF
Analyte	4/17/01	10/22/01	4/17/01	10/22/01	
1,1,1-Trichloroethane	ND	10	ND	0.43 J	200
1,1-Dichloroethane	ND	15	27	23	3650
1,1-Dichloroethene	16	86	ND	ND	7
1,2-Dichloroethane	ND	4.6	0.52 J	0.7 J	5
Benzene	ND	ND	ND	0.52 J	5
Chloroethane	ND	ND	2	1.2	29.4
Cis-1,2-Dichloroethene	66 D	200	5	5.4	70
Tetrachloroethene	190	920	ND	0.47 J	5
Trans-1,2-Dichloroethene	ND	ND	ND	0.47 J	70
Trichloroethene	350	1400	ND	0.49 J	5
Vinyl Chloride	ND	ND	5	5.4	2
Uranium-233,234 (pCi/l)	15	17.7	2.13	-	1.06
Uranium-235 (pCi/l)	0.57	0.974 J	0.044 U	-	1.01
Uranium-238 (pCi/l)	13	11.7	1.71	-	0.768

U = Under the detection limit
J = Detected at concentrations below the detection limit for this analysis
N/A = Not Applicable
ND = Not detected at the detection limit for this analysis

Well 15699 is located within the major preferential flow path for the Mound Site Plume and along the trend of the highest plume concentrations defined in the pre-remedial investigation (DOE 1999). The analytical results from the sample collected during the pre-remedial investigation from groundwater in nearby Geoprobe™ hole 10797 were 844 μg/l trichloroethene, and 261 μg/l tetrachloroethene. These analytical results are the same order of magnitude as those seen in Well 15699. Continued fluctuations of contaminants in wells, such as 15699, within the plume and upgradient of the collection/treatment system are expected. Well 3586 is located downgradient of the collection system and near South Walnut Creek. Water quality at this location generally meets the Tier II RFCA Action Levels.

Water levels within the collection trench were monitored at five piezometers and measured quarterly. The piezometer at the west end of the collection trench has been dry throughout the year. Water levels measured in the rest of the piezometers are fairly constant, with water levels in these piezometers varying less than 0.1 foot over the year.

Groundwater levels were also monitored quarterly at seven locations surrounding the collection trench (three upgradient, three downgradient, and one to the east) as shown in Table 15. Groundwater elevation upgradient of the collection trench was approximately 5,920 feet. Groundwater elevation downgradient of the collection trench was 10 feet lower at around 5,910 feet, with piezometer 15599 being consistently dry. These data indicate that the collection system is working as designed and that flow is towards the trench. Seasonal water fluctuations are approximately 2-3 feet at both upgradient and downgradient locations. Water levels in Well 3586, near South Walnut Creek, were about 5,900 feet and are likely to be influenced by the nearby Creek.

Table 15

Recent Mound Plume Upgradient and Downgradient Water Elevations

Well	Location	1/4/01	4/2/01	7/5/01	10/3/01
15199	Eastern	5917.01	5917.48	5919.81	5917.63
15299	Upgradient	5915.2	5918.78	5917.52	5915.8
15399	Upgradient	5917.48	5917.57	5918.19	5916.8
15499	Upgradient	5918.05	5918.28	5918.88	5918
15599	Downgradient	Dry	Dry	Dry	Dry
15699	Downgradient	5907.5	5907.67	5908.66	5908.24
15799	Downgradient	Dry	Dry	5910.72	5909.99

The collection trench collects groundwater from across the plume area, including lower concentration areas. Historical concentration of trichloroethene within the collection trench ranges from 67 to 160 µg/l. Because of the similarity between the pre-accelerated action downgradient water quality and the disparity between the collection trench water, the contaminant concentrations in groundwater observed in Well 15699 are likely a result of the pre-existing downgradient plume. This conclusion is supported by the groundwater elevation difference between the upgradient and downgradient wells and indicates that the collection system is working as designed.

Question A. Is the Accelerated Action functioning as intended by the Decision Documents?

Yes. Water level measurements collected in adjacent piezometer and monitor wells indicate the collection trench is effectively dewatering the previously existing downgradient aquifer. Routine influent and effluent monitoring indicates removal efficiency of the treatment system is greater than that of laboratory bench tests and as anticipated in the Decision Document. Influent and effluent water quality data indicates all contaminants of concern are reduced to concentrations well below the standards agreed upon in the Decision Document and RFCA.

Question B. Are the exposure assumptions, toxicity data, and accelerated action objectives used at the time of the action still valid?

Yes. The exposure assumptions still remain to the South Walnut Creek and associated human and/or environmental receptors. Water quality monitoring indicates no significant impacts to the creek. Toxicity data and the accelerated action objectives for the project remain consistent with the decision document as listed below.

- Contaminated ground and seep water is intercepted and treated at the distal end of the Mound Site Plume.
- The passive groundwater collection and treatment system protects surface water and reduces the contaminant mass loading in surface water consistent with the ALF.
- The treatment system was designed for low cost and effective long term, ease of operation and maintenance, specifically media replacement and final removal.
- The collection and treatment system was designed and installed with construction methods that minimized the generation of wastes.

- Potential impacts to possible Preble's meadow jumping mouse habitat during construction and operation were minimized by design.
- Depletion of waters to the South Walnut Creek and ultimately, the South Platte River is negated by inputs to the South Walnut Creek from the collection and treatment system via the discharge gallery.

Question C. Has any other information come to light that could call into question the protectiveness of the Accelerated Action?

No.

8.3.8 East Trenches Plume Accelerated Action

Verification of Accelerated Action

Groundwater level monitoring, up and downgradient of the collection system, indicates the surficial aquifer is effectively dewatered by the system. Groundwater quality monitoring in the same locations has not indicated a substantial decrease in downgradient contaminant concentrations. This should improve as the downgradient groundwater is discharged and the system continues to remove and treat upgradient groundwater. Water quality monitoring in South Walnut Creek indicates the objectives of the accelerated action are met.

The installation of the treatment and collection system was documented in the project completion report in February 2000 (DOE 2000a). The performance of the system is monitored and reported in the "Annual Report for the Rocky Flats Environmental Technology Site Groundwater Plume Treatment Systems" and summarized in the following table.

Table 16, Summary of East Trenches Plume FY 2000 Sample Results

Compound	Influent Concentration (µg/l)	Effluent Concentration (µg/l)	RFCA Groundwater Tier II Action Levels (µg/l)
1,1-Dichloroethane	ND	1-1.5	3650
1,1-Dichloroethene	ND-4.9J	ND	7
Cis-1,2-Dichloroethene	ND-32	5-6.6	70
2-Methyl-butane		1.1J	No Tier II Action Level
2-Methyl-1-Propene		1.6	No Tier II Action Level
1,1,1-Trichloroethane	ND-6.2	ND	200
Acetone	ND	ND-3.5J	3650
Benzene	ND	ND-0.42J	5
Carbon Tetrachloride	160	ND	5
Chloroform	79J-84	ND	100
Methylene chloride	ND	ND-15	5
Propene		12J	No Tier II Action Level
Tetrachloroethene	240-350	0.6J -5.3	5
Trichloroethene	2,500-2,900	ND-0.66J	5

J = Detected at concentrations below the detection limit for this analysis
ND = Not detected at the detection limit for this analysis

Analytical samples were collected where possible from the three downgradient wells and one well east of the collection trench. As is common to the site in general, some of the designated adjacent monitoring wells are often dry at various sampling times. The below table summarizes the results of analysis of samples collected from downgradient wells.

Table 17, Downgradient Well Analytical Results (in μg/l)

Well	Date	Carbon Tetrachloride	Chloroform	Cis-1,2-Dichloroethene	Methylene Chloride	Tetrachlo-roethene	Trichloro-ethene
23296	4/24/01	6 J	16	63	10 B	17	530
	10/23/01	10	10	150	ND	12	380
95099	4/01/01	ND	ND	ND	ND	ND	ND
	10/22/01	0.2 J	ND	ND	ND	ND	ND
95199	4/12/01	ND	ND	2	ND	2 JD	65
	10/23/01	ND	ND	2.5	ND	2	51
RFCA Tier II AL		5	100	70	5	5	5

B = Present in the laboratory blank (possible lab contamination)
J = Detected at concentrations below the detection limit for this analysis
ND = Not detected at the detection limit for this analysis

Wells 23296 and 95199 show consistent VOC concentrations higher than the RFCA Tier II Action Levels (Table 17), although much lower than the concentrations seen at the treatment cells (Table 16). These downgradient wells are located within the downgradient portion of the plume that was not intended to be treated. Well 95099 is located east of the collection system and outside of the East Trenches Plume. It was installed to monitor evidence that the plume was not spreading to the east as a result of the collection system. Water quality at this location has remained substantially unchanged historically including during the current reporting period as shown in Table 17.

Well 23296 is located near South Walnut Creek where the East Trenches Plume exits to surface water. Higher VOC concentrations observed at this well were an early indication that a remedial action should be considered for this plume. Trichloroethene was the primary contaminant observed, with concentrations ranging between 380 μg/l in October 1999 to 5300 μg/l in February 2000. Well 95199 exhibits the same pattern as Well 23296, but to a lesser extent with the highest concentrations of trichloroethene observed in March 2000 and the lowest concentration in October 1999.

The East Trenches Plume Treatment System is fully operational and treating contaminated groundwater to below the system performance requirements specified in the PAM and listed in the above table. Ongoing maintenance (i.e. raking the iron filings and retrieving flow rate and water level data) is the only required activitiy. Sampling of the treatment system is expected to continue semiannually. Analytical results will be monitored closely for signs that indicate the iron is becoming exhausted and must be replaced.

Protectiveness Summary

Question A. Is the accelerated action functioning as intended by the decision document?

Yes. The system functions as intended by the decision documents and meets the objectives listed above. The treatment system is currently removing a greater percentage of the contaminants than was forecast by previous treatability studies and envisioned during design.

Question B. Are the exposure assumptions, toxicity data, and accelerated action objectives used at the time of implementation of the accelerated action still valid?

Yes. The contaminant exposure location for the COCs remains at North Walnut Creek. Toxicity data for the primary COCs and the resultant performance standards for the system remain as assumed in the 1999 East Trenches Plume PAM. The objectives for the accelerated action remain consistent as described below:

- Volatile organic compound (VOC) contaminated groundwater is intercepted and treated at the distal (northern) end of the East Trenches Plume.
- Surface water is protected by the system by reducing the VOC contaminant mass loading to the extent practicable.
- The system design and installation resulted in reduced operation and maintenance costs, especially media replacement, when necessary.
- The project was designed to minimize the impact to the Preble's meadow jumping mouse during construction and operation.
- Depletion of waters to the South Walnut Creek and ultimately, the South Platte River is negated by inputs to the South Walnut Creek from the collection and treatment system via the discharge gallery.

Question C. Has any other information come to light that could call into question the protectiveness of the accelerated action?

No.

8.3.9 Solar Pond Plume Accelerated Action

Verification of Accelerated Action

The installation of the treatment and collection system was documented in the project completion report (DOE 2000b). The collection and treatment of groundwater downgradient of the SEPs will continue until concentrations of uranium and nitrate reach acceptable levels. The two-stage treatment system is currently removing a greater percentage of the contaminants than was forecast by previous treatability studies. Nitrates and uranium concentrations in the treatment system effluent are well below the standards established in the SPP IM/IRA. The effectiveness

of the collection system is currently under evaluation. Possible future modifications and/or additions to the existing system will be documented in a separate decision document.

The original design of the system placed the treatment cell sufficiently downgradient of the collection trench that water would gravity flow from the trench into the treatment system. The presence of an endangered species and associated buffer zone habitat in the planned location of the treatment cell resulted in its installation directly adjacent to the collection trench. This configuration requires approximately eleven vertical feet of water within the collection trench before gravity flow into and through the treatment system can occur. The eleven feet of head within the collection trench increases the likelihood of water migrating around, through, or beneath the barrier material, bypassing the treatment system and potentially decreasing the effectiveness of the collection system.

The second source of water containing elevated nitrates is that portion of the plume, which is located downgradient of the collection system. This portion of the plume was referenced in the IM/IRA and is located well within the buffer zone and habitat area of the Preble's mouse. One localized area exhibits some of the highest nitrate concentrations currently within the SPP and is adjacent to the discharge gallery for the treatment system. Groundwater in this area of the plume is apparently discharging to the gallery and contributing to the elevated nitrate concentrations observed in water samples collected at the gallery.

The two-stage treatment system is currently removing a greater percentage of the contaminants than was forecast by previous treatability studies. Nitrates and uranium concentrations in the treatment system effluent, <6 mg/l and <.2 pCi/l respectively, are well below the standards established in the SPP IM/IRA. A summary of the annual analytical results for the SPP influent, effluent, and the SPP discharge gallery is contained in the Table 18 below.

Table 18 Summary of Solar Ponds Plume Treatment System FY00 Analytical Results

	SPP Influent		SPP Effluent		SPP Discharge Gallery	
Collection date	Nitrate in mg/l	Total Uranium in pCi/l	Nitrate in mg/l	Total Uranium in pCi/l	Nitrate in mg/l	Total Uranium in pCi/l
30-Jan-01	140	25.06	-	-	130	25.66
26-Feb-01	150	26.44	-	-	140	24.51
19-Mar-01	120	25.58	0.07	0.15	110	28.84
13-Apr-01	140	24.43	<0.05	0.003	120	20.2
25-Apr-01	130	24.58	<0.05	0.05	130	28.55
3-May-01	110	24.82	0.13	0.091	150	24.79
8-May-01	150	23.66	5.3	0.11	140	26.6
23-May-01	130	27.97	<0.05	0.002	180	31.16
21-Jun-01	120	25.49	<0.05	0.168	220	50.38
16-Jul-01	150	21.3	0.11	0	130	55.4
10-Aug-01	140	24.51	<0.05	0.1	150	28
26-Sep-01	109	26.22	-	-	202	41.64
31-Oct-01	168	22.64	-	-	257	37.15
30-Nov-01	212	nr	-	-	268	nr

not sampled
nr – not received

The distal portion of the plume, downgradient of the collection and treatment system, is apparently impacting water quality at the discharge gallery. Water bypassing the collection system may also be contributing to the elevated nitrate and uranium concentrations at the discharge gallery. Nitrate and uranium concentrations at the discharge gallery ranged from 110 to 268 mg/l and 20.2 to 55.4 pCi/l, respectively during January through November of 2001. Even though elevated, the nitrate concentrations are well below the calculated maximum effluent concentration of 500 mg/l nitrate to ensure meeting the temporary performance monitoring standard of 100 mg/l in the adjacent surface water. The maximum nitrate value (268 mg/l) was observed at the discharge gallery on November 30, 2001, with similar values noted in October and December. Analysis of concurrent water samples collected at GS-13, the surface water performance monitoring location downstream of the discharge gallery, indicates the underlying stream standard of 10 mg/l for nitrate will be met despite elevated levels at the discharge gallery. A summary of surface water quality at the discharge gallery and down stream monitoring locations is presented in the following table.

Table 19 Solar Ponds Plume Summary of Down Stream Surface Water Locations

Date	**SPP Discharge Gallery**	**GS13**	**Pond A-3**	**SPP Discharge Gallery**	**GS13**
	Nitrate (mg/l)			Total Uranium (pCi/l)	
30-Jan-01	130	20	7.9	25.66	9.15
26-Feb-01	140	18	11	24.51	8.85
19-Mar-01	110	13	8.2	28.84	5.89
13-Apr-01	120	7.8	4.1	20.2	2.999
25-Apr-01	130	10	5.4	28.55	2.936
3-May-01	150	2.9	4.5	24.79	1.328
4-May-01	130				
8-May-01	140	12	5.3	26.6	4.08
23-May-01	180	15	5.6	31.16	5.53
21-Jun-01	220	4.3	2.9	50.38	2.33
16-Jul-01	130	11	2.2	55.4	3.705
10-Aug-01	150	8.9	1.5	28	4.4
26-Sep-01	202	27.4	1.9	41.64	9.18
31-Oct-01	257	26.5	4.9	37.15	8.02
30-Nov-01	268	20.2	7	32.48	7.89
28-Dec-01	211	26.5	7.7	35.8	9.9
Minimum	110	2.9	1.5	20.2	1.328
Maximum	268	27.4	11	55.4	9.9
Average	166.8	14.9	5.3	32.7	5.75

Protectiveness Summary

Question A. Is the accelerated action functioning as intended by the decision document?

Yes. The system functions as intended by the decision documents and meets the objectives listed above. However, water quality at the discharge gallery indicates adverse impacts from two potential sources.

Question B. Are the exposure assumptions, toxicity data, and accelerated action objectives used at the time of implementation of the accelerated action still valid?

Yes. The contaminant exposure location for both COCs remains at North Walnut Creek. Toxicity data for the primary COCs, nitrate and uranium, and the resultant performance standards for the system, remain as assumed in the 1999 Solar Ponds Plume IM/IRA. The objectives for the accelerated action remain consistent as described below:

- The Temporary Modification to the Big Dry Creek Segment 5 water quality standard for nitrate (100 mg/l)and the ambient standard for uranium (10 pCi/l) is currently met in North Walnut Creek. In addition, recent monitoring results indicate that the underlying nitrate standard of 10 mg/l will be met when the temporary modification expires in 2009.

- The SPP system provides a long-term, passive solution to the movement of contaminated groundwater from the SEP area to North Walnut Creek.

- The accelerated action supports the goal of site closure within 10 years.

- SPP water management and treatment costs, previously associated with the operation and maintenance of B-374, are substantially reduced.

- The fiscal year 1999 milestone for initiating remediation of the SPP was met.

Question C. Has any other information come to light that could call into question the protectiveness of the accelerated action?

No. Water quality monitoring in North Walnut Creek indicates the objectives of the accelerated action are being met. However, the elevated nitrate and uranium concentrations at the discharge gallery indicate leakage from the collection system and/or discharge from the adjacent distal portion of the plume.

Conclusion

The effectiveness of the treatment and collection system may be affected by the potential for water to by pass the treatment cells. Possible corrective or additional/alternative actions will be evaluated concurrent with the decision document for the Solar Evaporation Ponds. A modification to the 1999 SPP IM/IRA or a new decision document will implement any selected actions before the next 5 year review.

8.3.10 Source Removal at the Solar Evaporation Ponds

Following removal of sludge and water, the ponds were rinsed and the water pumped to B-374 for evaporation. The ponds were then considered RCRA empty.

Protectiveness Summary

Question A. Is the Accelerated Action Functioning as intended by the decision documents?

Yes. The sludge was removed from the SEPs utilizing site procedures developed in compliance with RCRA operating requirements for the Interim Status Unit. A modification was made to the Site's RCRA permit to facilitate installation and operation of the double walled sludge storage tanks on the 750 Pad. A CERCLA decision document was not prepared for the source removal. The intent of the action was to remove the potential source of soil and groundwater contamination from the Solar Evaporation Ponds. The sludge was removed from the ponds and is currently safely stored in RCRA permitted tanks within tents on the 750 Pad.

Question B. Are the exposure assumptions, toxicity data, and RAOs used at the time of the accelerated action still valid?

Yes/Not Applicable. The accelerated action eliminated the source of potential exposure to human health and the environment. The corrective action or closure of the SEPs and additional groundwater actions will be evaluated and documented in separate accelerated actions.

Question C. Has any other information come to light that could call into question the protectiveness of the accelerated action?

No. The source of contamination from the SEPs was removed and safely stored in permitted tanks. The SEPs were rinsed and the rinse water was treated by evaporation in Build 374. Subsequent action to address residual contamination associated with the SEPs is currently being planned. This action may include RCRA unit closure and hot spot removal prior to pushing in the berms around the SEPs.

Conclusion

The accelerated action removed the primary risk to human health and the environment posed by the SEPs. Subsequent actions will further address corrective action for the RCRA Interim Status Unit and effectiveness of the Solar Ponds Plume collection and treatment system.

8.3.11 OU 7 Seep Accelerated Action

Verification of Accelerated Action

Water samples collected from the influent and effluent performance monitoring points indicates the aeration treatment system generally meets the RFCA standards listed in table 6. The early performance of the system was documented in the Evaluation of OU 7 Aeration Treatment System (Report), November 1998 – October 1999, completed and submitted as final to the regulatory agencies in August of 2000 (K-H 2000a). The sampling and analysis requirements developed by the evaluation were documented in the sampling and analysis plan for performance monitoring of the system, as submitted in final form in April of 2001 and approved by the regulatory agencies in July, 2001 (K-H 2001a). Samples are collected and analyzed semi-

annually in June and December. The performance of the OU-7 seep collection and treatment system is now reported in the Annual Report for the Rocky Flats Environmental Technology Site Groundwater Plume Treatment Systems (K-H 2001c).

The analytical results are compared to the performance standards in table 6. Benzene is commonly detected at concentrations of 1 to 2 ug/l. The RFCA standard for benzene in Segment 4 is 1 ug/l. The SAP states that if a RFCA standard is exceeded in the semi-annual monitoring, then a sample will be collected and analyzed the month following receipt of validated data. Preliminary data are received from the analytical laboratory within a month of sampling and validated results are received one month later. Therefore, based on analytical results, sampling was performed quarterly in 2001 for benzene. The results are shown below in Table 20 for the years 2000 and 2001.

Table 20 Benzene Concentration in Present Landfill Leachate Treatment System Effluent

Month	Benzene Concentration (μg/l)
June 2000	1
July 2000	1 (special sample)
December 2000	2
March 2001	1
June 2001	2 (duplicate sample concentration was 1 μg/l)
September 2001	1.4
December 2001	0.3 (estimated, below detection limit)

Note: The result for September 2001 was reported to the tenth of a microgram because of differences in protocols and reporting between different laboratories.

The water discharging from the OU 7 seep treatment system into the Landfill Pond meets all surface water action levels, except benzene on an intermittent basis. Benzene is not an analyte of interest at either the A-4 or the Walnut and Indiana Street Points of Compliance.

The need for the OU 7 seep treatment system will be evaluated as part of the OU 7, Present Landfill IM/IRA.

Protectiveness Summary

Question A. Is the accelerated action functioning as intended by the decision document?

Yes. The system functions as intended by the decision documents and generally meets the objectives listed above. As discussed, benzene concentrations are typically at or 1 ug/l above the Segment 4 RFCA standard of 1 ug/l.

Question B. Are the exposure assumptions, toxicity data, and accelerated action objectives used at the time of implementation of the accelerated action still valid?

Yes. The contaminant exposure location for the COCs remains at North Walnut Creek. Toxicity data for the primary COCs and the resultant performance standards for the system are reviewed

on an annual basis. The objectives for the accelerated action remain consistent with the approved sampling and analysis plan for the accelerated action.

Question C. Has any other information come to light that could call into question the protectiveness of the accelerated action?

No. Additional action is currently being planned for the Present Landfill itself. It is anticipated that a cover will be constructed as the remedy for OU 7.

Conclusion

The OU 7 Seep collection and treatment system is protective of surface water and is meeting all accelerated action project objectives.

8.3.12 Underground Storage Tanks Source Removal Project

Verification of Source Removal

Table 2-1 in the Closeout Report (RMRS 1996e) summarizes the quantity of residual liquid and sludge removed from the tanks along with the volumes of rinse water used in cleaning each tank. An influx of groundwater was detected during the liquid removal from the underground tank in February, March, and April 1996 was removed. The liquid encountered likely originated from groundwater infiltration and precipitation/surface water runoff into the three chamber man ways. Tank T-10 had no influx from groundwater. Liquids and sludge removed from the T-10 tanks were pumped via pipeline into T-16 for handling, and then into Building 774. Tanks T-14 and T-16 had no influx of groundwater detected during content removal. All residual liquids and sludge were removed from each of the USTs. Each tank was then triple-rinsed to remove bulk contamination in accordance with the Accelerated Action Plan. Table 3-1 of the Closeout Report summarizes the analyses performed on the rinsate screening samples and the analytical methods used. In each tank, a sample of the final rinsate water was collected for comprehensive analysis to document the extent of contamination remaining.

Table 3-1 of the Closeout Report also summarizes the analyses performed on the final rinsate samples and the rinse water baseline samples. Tables 3-2 through 3-6 of the Closeout Report summarize the rinsate screening sample analytical results. Appendix B contains summary tables of the analyses of final rinsate samples. The final rinsate samples were not compared to clean closure standards but were compared by plotting the measured concentrations of total VOCs and total metals. The resulting decreasing trend in contaminant concentrations indicates that the bulk contamination was removed from each tank during the first and second rinse.

All six tanks were filled with an inert closed-cell foam (polyurethane) to stabilize residual contamination and prevent influx of groundwater and/or surface water until final disposition of the tanks is determined. The polyurethane foam is designed to stabilize the residual contamination in the tanks by preventing contaminant migration from the tanks to the surrounding groundwater, as well as preventing infiltration of groundwater, surface water, or pipe flow into the tanks.

The six tanks will each be dispositioned when its respective building is demolished, with the exception of the demolition of Building 889. Tank 40 remained along with the building floor slab, foundation sumps, and process waste lines. Tank 40 will be dispositioned in early Spring 2001 along with the Building 889 floor slab.

Question A: Is the accelerated action functioning as intended by the decision document?

Yes. The accelerated action is functioning as intended to stabilize the residual contamination, and minimize groundwater and surface water infiltration. The polyurethane foam is still in place.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the accelerated action still valid?

Yes. The action was to remove the liquid and solid contents of each tank, triple rinse, and foam in place.

Question C: Has any other information come to light that could call into question the protectiveness of the accelerated action?

No. The tanks have remained as is, and will be removed when the decontamination and decommissioning of its associated building and environmental restoration scope of work occurs.

Conclusions

The accelerated action for the six tanks was completed as intended in the Accelerated Action Plan and the PAM. The tanks remain in a stabilized condition, and will be removed when the associated building is decontaminated and decommissioned, and environmental restoration scope of work is undertaken.

9.0 Issues

This section details the issues related to current site operations, conditions, or activities, noting which issues currently prevent the remedies or accelerated actions from being protective. Since much of the overall Site remedy is yet to be determined by the RI/FS and implemented in the final CAD/ROD, current issues focus on individual site-specific issues identified in section 8.0 of this report. In addition, there are a number of issues currently being addressed, which will need to be resolved prior to the next Five-Year Review in order to ensure future protectiveness of the remedies and accelerated actions. Some of these issues are also discussed below.

Current Issues

Trench 1 Source Removal:

Containerized wastes from Trench 1 containing depleted uranium contaminated with PCBs do not have an identified treatment or disposal option. While this is not an immediate issue because

the waste is stored in compliant storage areas, it could become an issue if a disposal option is not identified and implemented prior to Site closure. There are no current plans for waste storage on site after Site closure.

Solar Ponds Plume:

Elevated nitrate and uranium concentrations at the Solar Pond Plume discharge gallery have the potential to compromise compliance with future stream standards in North Walnut Creek. Monitoring has been proposed to track this concern in the near term. Alternatives to the existing configuration are being investigated to address long-term operability concerns. The existing configuration has not impacted surface water compliance, but a change to the system is desirable to address the potential to by pass the treatment cell.

Potential Long-Term Issues

Below is a discussion of potential issues, which require resolution to ensure future protectiveness of the remedy. These issues are currently being addressed and it is anticipated that they will be resolved prior to Site closure. These issues are highlighted, in part, to stress their importance and to ensure the long term stewardship mission of the Site continues to be protective.

Sitewide Actions

Lack of definition of all areas requiring access restrictions after Site closure:

Since cleanup is not complete, areas that will require access restrictions cannot be defined yet. It is anticipated that sufficient details regarding contaminated areas will be obtained to prevent this from becoming a problem in the future; however, boundaries of contaminated areas requiring restrictions after remediation is completed have not been specified. In addition, any necessary controls, such as signs and barriers, will need to be evaluated as part of the RI/FS and implemented prior to closure of the Site.

Ecological Risk:

Ecological risk has not been adequately analyzed or addressed with respect to establishing cleanup levels. To date, cleanup levels have been established primarily based on risk to human health verses ecological risk. It is expected that human health risk will be the driver for most cleanup actions. However, there may be instances were action levels for particular COCs at specific cleanup sites are more restrictive when evaluating risk to the Site ecology. An ecological risk assessment will need to be included in the CRA in order to evaluate ecological risk impacts to cleanup actions.

Land transfer and management responsibilities:

At closure, most of the site will be transferred to the U.S. Fish and Wildlife Service for management as a national wildlife refuge. A Comprehensive Conservation Plan will be developed which is expected to address overall management of the wild life refuge.

Requirements described in the memorandum of understanding and the Comprehensive Conservation Plan will need to be developed that ensure that management of the refuge is consistent with maintaining future protectiveness of the remedy after land transfer.

Post Closure Enforcement:

Environmental regulatory enforcement at RFETS is currently governed by RFCA. However, post closure enforcement, monitoring, and water management have yet to be defined and will need to factor in the land transfer to the Fish and Wildlife Service. It is anticipated that post closure enforceable requirements will be part of the final CAD/ROD and any follow-on orders/post closure permits. DOE expects that both EPA and CDPHE will have post closure enforcement authority.

Funding for long-term activities:

Because of a number of factors, not the least of which is the lack of a comprehensive final remedy at this stage of cleanup; the cost for post closure long-term activities is difficult to estimate. CDPHE and some stakeholders are concerned that once closure is complete the Site may lack priority when it comes to funding post closure activities. DOE believes that sufficient funding can be obtained through the normal annual funding cycle to ensure the remedy remains protective and does not anticipate this will be an issue. Post closure requirements will need to be funded in order to ensure future protectiveness.

Specific Actions:

Reactive Barriers Operation and Maintenance (O&M) Requirements:

In order to address groundwater plumes the site has installed three passive reactive barrier systems, which will operate after closure. These systems employ relatively new technology and have not been operating for a long time at RFETS. The technology was selected in part because of minimal long-term O&M requirements. However, the long-term O&M requirements will need to be developed and implemented based on current operating experience.

10.0 Recommendations

The Five-year Review identified several issues relevant to a determination that the identified remedies and accelerated actions are protective and should be considered as the Site proceeds with the cleanup pursuant to RFCA. As noted above in section 9.0, some of these issues are current issues and some of these issues are potential future issues. For each of the issues identified above, recommendations for addressing them are presented in the Table 21 below:

Table 21

Issue	Near-term Recommendation	Long-term Recommendation	Milestone Date	Affects Protectiveness
(Site-wide) Lack of definition of areas requiring access restrictions	Current access restrictions across the site are effective. However, new accelerated actions should provide a better description of areas above unrestricted use levels and should describe future long-term controls.	Unrestricted use levels and boundaries, and implementing mechanisms, should be defined in the RI/FS, CRA and the final CAD/ROD.	2007	Not currently. Could affect long-term protectiveness
(Site-wide) Ecological Risk	Conduct site specific and a site-wide ecological risk assessment. Analyze if action levels based on the ecological risk assessment drive cleanup levels for specific accelerated actions.		12/31/02	Possibly. An eco risk assessment is pending and action to address eco risk will be taken as necessary.
(Site-wide) Land transfer and management responsibilities	Negotiate the memorandum of understanding to identify management arrangements and their protectiveness for existing and anticipated remedies.	Implement land management that adequately considers long-term effectiveness and continued protectiveness for each remedy.	6/30/2003	Not at this time. DOE expects this issue will be resolved satisfactorily.
Post Closure Enforcement	RFCA currently provides an adequate mechanism for regulatory enforcement.	Define post closure enforcement in the CAD/ROD and any follow-on orders and/or permits, to link enforceable requirements to future protectiveness for each remedy.	2007	Not at this time. DOE expects this issue will be resolved satisfactorily.
Funding for long-term activities	DOE currently expects to rely on the annual funding cycle through closure.	Complete budget cost estimates to accurately reflect the actual costs of specific actions. In addition, evaluate alternative funding mechanisms to provide adequate funds over the long-term.	12/31/2005	Not at this time. DOE expects this issue will be resolved satisfactorily.
Containerized wastes from Trench 1 containing DU contaminated with PCBs do not have an identified treatment or disposal option	Continue to store these materials in compliant storage areas until treatment/disposal options are identified and implemented.		6/30/2005	Not at this time. DOE expects this issue will be resolved satisfactorily.
Solar Ponds Plume reactive barrier operability	Monitoring will track this concern in the near term. Evaluate and implement corrective actions to address the potential to by pass the treatment cell.	Continue long-term monitoring to appropriately evaluate the effectiveness of corrective actions.	6/30/2003	Not in the near term. Could affect long-term protectiveness
Reactive Barrier O&M Requirements	Develop long-term O&M requirements base on current operations.	Continue long-term monitoring to implement an effective O&M program.	12/31/2005	Not at this time. DOE expects this issue will be resolved satisfactorily.

11.0 PROTECTIVENESS STATEMENT

Ongoing custody and control of the Site by DOE, monitoring programs, and restriction of public access serve to adequately control risks posed by contamination at RFETS at this time. In addition, DOE has every intent of implementing the requirements of RFCA, CERCLA and RCRA to cleanup and close the Site in a manner that is protective of human health and the environment. This final remedy will be developed as part of the RI/FS process, resulting in a final CAD/ROD that is protective.

RFETS has completed several remedies for a number of OUs. For OU 1 and OU 3, the remedies as discussed in this report are protective.

RFETS has also completed several accelerated actions to address hazards posed on an individual IHSS basis. For the accelerated actions analyzed during this Five-Year Review, the immediate hazard has been addressed. Further, for the most part, the accelerated actions are protective and are functioning as intended. Deficiencies are noted in section 9.0, Issues, and are addressed in section 10.0, Recommendations. A summary of the protectiveness of the OUs and accelerated actions analyzed during this review is shown in the Table 22.

Table 22 Protectiveness Summary

OU/Accelerated Action	Protectiveness Assessment
OU 1, 881 Hillside	The remedy is protective.
OU 3, Off-site Areas	The remedy of no action is protective.
OU 7 Leachate Seep Treatment System	The accelerated action is protective and functioning as intended. Additional action is being planned for the Present Landfill itself which may impact the leachate treatment system.
Trench 1	The source removal action is protective. The DU waste contaminated with PCBs currently does not have a treatment/disposal option identified.
Trench 3/Trench 4	The source removal action is protective.
Ryan's Pit, Trench T-2	The source removal action is protective.
Mound Site	The source removal action is protective.
Mound Plume	The reactive barrier and treatment system is protective and functioning as intended.
East Trenches Plume	The reactive barrier and treatment system is protective and functioning as intended.
Solar Ponds Plume	The existing configuration currently protects human health and the environment because there has been no impact to surface water compliance, but a change to the system is desirable to address the potential to by pass the treatment cell.
Solar Ponds Sludge Removal	The source removal action is protective. Additional action is being planned for the final remedy of the Solar Pond area.
IAG UST Source Removal	The source removal action is protective.

12.0 NEXT REVIEW

The next review for RFETS should be conducted five years from the issuance of this Five-Year Review Report. The next review is expected to cover a comprehensive site-wide remedy for RFETS.